Consumer payment choices

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Consumer payment choices: Room for further digitisation?

ANNEKE KOSSE

TILBURG UNIVERSITY

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I wrote this thesis whilst working at the Nederlandsche Bank (DNB). When I started my job in 2006, my very first task was to estimate the number of cash payments made in the country. As cash is commonly used by everyone, I thought this would not be too difficult, but I was wrong. Very soon I realised that studying cash usage requires a study in itself. However, that it would ever become part of a PhD thesis, I would have never expected. In fact, a few years ago I would not have dared to dream that I would write a PhD thesis at all. I was just doing my job studying the payment habits of consumers. Initially, the studies mainly served a policy-supporting purpose, but they gradually became more of a scientific nature. Once they got published as working papers and in scientific journals, it was my colleague Nicole Jonker who raised the idea of using these publications as a basis for a PhD thesis. Thanks to her, I decided to contact Ron Berndsen, who was happy to supervise me together with Sylvester Eijffinger.

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underlying Chapter 3, a large share of the work is from your hands. Also, I am thankful for the enjoyable way of working together.

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This thesis contains four empirical chapters, each of which is based on work that has been published in the Journal of Banking & Finance (2), the International Journal of Central Banking and De Economist. I am extremely thankful to the editors for their permission to use this work. Also, I like to thank the anonymous referees for their useful comments. In addition, I thank participants of the various conferences and other venues where parts of the work were presented. I also like to thank CentERdata, Equens, GfK, TNS Nipo and Veldkamp for supplying the data used in this thesis.

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Anneke Kosse
Nieuw-Vennep, 2014

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Chapter 1

Introduction

In this introductory chapter, we briefly present the main topic and focus of this thesis, as well as its relevance. First, we provide an overview of the key features and trends in retail payments, followed by a review of the existing literature on the factors influencing consumer payment choice. Subsequently, we introduce and discuss the main research topics, the central objective and the contribution of this thesis. Finally, we conclude by depicting the thesis' outline.

1.1 Introduction

Payments are part of everyday life. On average, consumers and businesses make about 1.1 payments a day, with an average value of EUR 305.[1] These payments, also called retail payments, play a vital role in our economy. Retail payments form the basis of all economic and financial activities and are therefore essential to overall financial stability. Also, there are numerous instruments available that payers can use to pay with, such as cash and cards for daily purchases, paper forms and online transfers for bill payments, and digital money and online banking applications for payment of online purchases. Given the different characteristics of each particular way of paying, the choices of consumers and businesses which instruments to accept and which ones to use are not without effect. On the contrary, these so-called payment choices have a direct impact on the safety and efficiency of our economy.

The use of payment instruments has considerably changed over the past decades. Due to technological advancements and changing user demands, there is a global trend towards cards and other electronic means of payment (CPSS (2012)). As a considerable amount of research has shown that a further replacement towards electronics may foster the social cost efficiency of a payment system (e.g. Humphrey, Willesson, Lindblom and Bergendahl (2003), Brits and Winder (2005), DCITA (2006)), there is a general

[1] Estimates refer to the total sum of cash and non-cash payments made in the euro area and in the countries represented in the Committee on Payment and Settlement Systems (CPSS) of the Bank for International Settlements (BIS) in 2011, and thus cover the following countries: Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovenia, Slovakia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States. Data on non-cash payments are taken from the European Central Bank (ECB) Statistical Data Warehouse, the BIS Red Book and the Federal Reserve Board. Estimates on cash usage are based on extrapolations of country estimates as reported in Jonker, Kosse and Hernández (2012). Due to lack of data, payments made outside the euro area and the CPSS countries, as well as cash payments between consumers are excluded.

global strive for further digitisation. In the meanwhile, cash and other paper-based instruments are still heavily used. Even the most advanced economies still rely heavily on cash, and cheques and paper credit transfers are still used across various developing as well as developed countries (e.g. CPSS (2012), Capgemini (2012)).

A substantial amount of research has been done in order to examine consumers' choices between payment instruments (see Bolt and Chakravorti (2012) for a synopsis). Overall, the decision what instrument to use for a particular transaction is found to be influenced by consumer demographics, as well as by transaction, situational and payment instrument characteristics. Despite the vast amount of literature, there are several topics that await further empirical exploration. Therefore, the main objective of this thesis is to study the motives and mechanisms underlying consumers' payment choices. More specifically, in three empirical studies, this thesis examines how consumers' choices between payment instruments are influenced by foreign backgrounds and payments safety. Herewith, this thesis aims to shed light on whether and how the use of electronic instruments can be further stimulated. However, having accurate data on the payment choices made by consumers is key to assessing the drivers underneath. The number and value of card and other non-cash payments are registered by banks and/or processors. By contrast, due to the anonymous nature of cash, actual data on the number and characteristics of cash payments are lacking. Therefore, this thesis first provides a profound empirical analysis of how to best measure consumers' payment behaviour, and in particular their use of cash.

This chapter first describes the key features of and trends in retail payments. Subsequently, Section 1.3 provides a review of the existing literature on the factors influencing consumer payment choice, while Sections 1.4, 1.5 and 1.6 present the major research topics, objective and contributions of this thesis. Finally, Section 1.7 depicts the thesis' outline.

1.2 Retail payments

1.2.1 Definition and description

Retail payments comprise all daily payments made by consumers and businesses. In terms of numbers of transactions, retail payments constitute the vast majority of all payments made within an economy. The remainder are payments between banks and other financial market participants, often referred to as wholesale payments. Though large in terms of numbers, retail payments are relatively small in value. In the euro area, for example, in 2011, on average, total retail payments amounted up to 471 million transactions a day, each one having an average value of around EUR 850.[2] By contrast, the average daily number of wholesale payments equalled 540 thousand transactions, each one having an average value of EUR 4.5 million.[3]

Retail payments also differ from wholesale payments in that they encompass a wide variety of transactions. First, consumers make a lot of payments in shops, at vending machines and other points-of-sale (POS). Also, payments are made face-to-face between consumers, called person-to-person (P2P) payments. POS and P2P transactions are often referred to as proximity payments, as they require payers and payees to be located at the same location. All other payments involve remote transactions where payers and payees do not need to be present at the same spot, such as payments of bills, social benefits, salaries and other recurring obligations, as well as one-off funds transfers.

In general, every retail payment constitutes a transfer of money between a payer and a payee. This money may take the form of either cash or account balances held at a bank or another payment institution. Cash

[2]Estimates are based on non-cash payments data taken from the ECB Statistical Data Warehouse and own calculations of cash usage based on extrapolations of country estimates as reported in Jonker et al. (2012).

[3]Data are taken from the ECB Statistical Data Warehouse and refer to the total number and value of euro payments processed in TARGET2, CLS and EURO1/STEP1 in 2011.

transfers simply involve a physical transfer of banknotes and coins. By contrast, for transferring funds between accounts, the payer gives an instruction to debit his or her account on behalf of the payee's. The tool used for giving this instruction is called a retail payment instrument. There is a great diversity of retail payment instruments, both within and between countries. Each instrument has its own features and functionalities and, hence, accommodates different types of transactions and needs. Most common are cheques, credit transfers, direct debits and cards. Cheques are written orders that require the payer's bank to pay out a specified amount from the payer's account. Cheques are typically handed over by the payer to the payee who delivers it to the bank. By contrast, when using a credit transfer, the payer directly gives the payment order to his or her bank, either via a paper form, by phone or via the internet. Direct debits also involve a direct payment order, yet initiated by the payee, usually based on a pre-authorised agreement with the payer. Also, payment cards allow the payer to initiate a transfer, either directly from a current account using a debit card, or via a credit card allowing for a payment delay based on a prearranged credit arrangement.

Over the past few decades, new payment instruments have emerged, thereby further enlarging the diversity of payment options. Yet, in most cases they are not fundamentally new methods of payment, but variations of the traditional instruments, simply transferring funds between accounts. Their innovative nature primarily lies within the devices (i.e. mobile phones, computers, contactless cards) or channels (i.e. internet, mobile communication networks) used to initiate the payment. Also, many innovations are new in that payments are no longer made from regular bank accounts, but from prepaid or online accounts, often offered by non-bank providers. Yet, most innovations still require the use of traditional bank accounts and the established instruments in order to prefund the underlying balances or to convert them into cash again (CPSS (2012)).

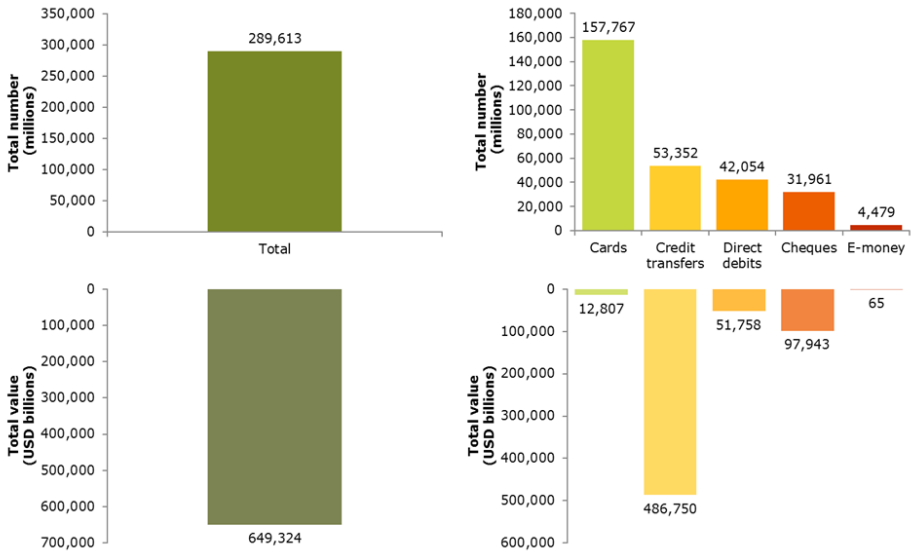
1.2.2 Current retail payment usage

The global number of non-cash retail transactions reached 290 billion in 2011 (see Figure 1.1).[4] With a market share of 54%, cards are by far most often used. Credit transfers follow at second, accounting for 18% of global non-cash transactions, whereas 15% and 11% is paid by direct debits and cheques. The use of electronic money solutions is limited, having an average market share of only 2%.

Despite the wide variety of non-cash instruments, the vast majority of payments is made in cash. Although cash payments are not systemically registered and, hence, global estimates are lacking, there are several pieces

[4]This estimate refers to the total number of non-cash payments made in the euro area and in the CPSS countries in 2011. Data are taken from the ECB Statistical Data Warehouse, the BIS Red Book and the Federal Reserve Board.

Figure 1.1: Global number and value of non-cash transactions (2011)



Note: This figure presents the total number and USD value of non-cash transactions made in the euro area and in the CPSS countries in 2011. Data are taken from the ECB Statistical Data Warehouse, the BIS Red Book and the Federal Reserve Board.

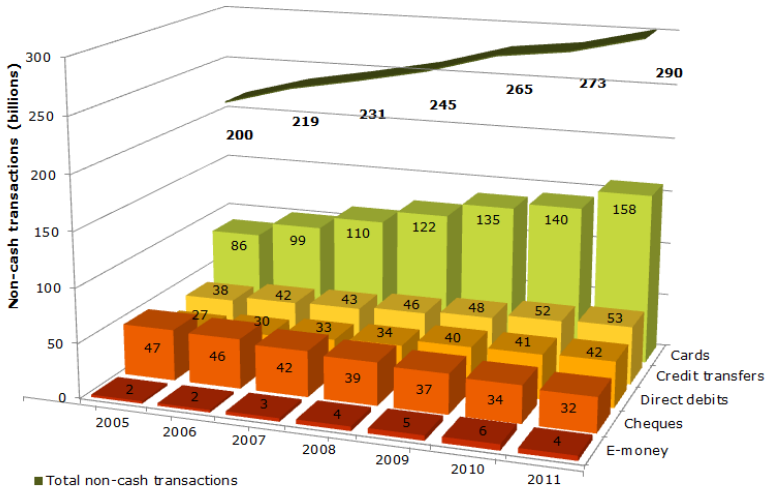
of evidence showing that, in particular at the POS and for P2P transactions, cash is with no doubt the most common instrument. The total estimated number of cash payments made in the United States and the euro area in 2009, for example, amounted up to 715 billion transactions (Capgemini (2012)). This represents a market share of around 80% of total retail payments. Similarly, a recent ECB study reveals that 65% of all retail transactions in the EU27 in 2009 was made in cash (Schmiedel, Kostova and Ruttenberg (2013)).

The picture differs in terms of value. As the average cash payment is generally low, cash accounts for a much smaller share in total value than in total transactions. For example, cash payments accounted for 2% of total retail value in de EU27 in 2009 (Schmiedel et al. (2013)). Similarly, cards often represent smaller transactions compared to the other non-cash instruments and therefore have a much smaller share in value. Instead, the largest share of global retail value is paid by credit transfers (see Figure 1.1).

1.2.3 Digitisation of retail payments

Payment habits have not always been like they are today. The use of payment instruments has changed dramatically over the past decades. Explanations may be found in various factors, such as changing demands of payers and payees, on-going technological advancements, cooperation and standardisation between payment service suppliers, as well as regulatory and financial incentives. They all affect the availability of instruments and the willingness and ability of payers and payees to adopt them (CPSS (1999), CPSS (2012)). Between 2005 and 2011, the global volume of non-cash payments grew by more than 45% from 200 to 290 billion transactions (see Figure 1.2). Also, the mix of non-cash payments has changed. In particular, there has been a strong growth in card payments. Globally, the share of cards increased from 43% in 2005 to 54% in 2011. Though less pronounced, direct debits and credit transfers also exhibited a steady increase, whereas check usage has steadily declined across the globe.

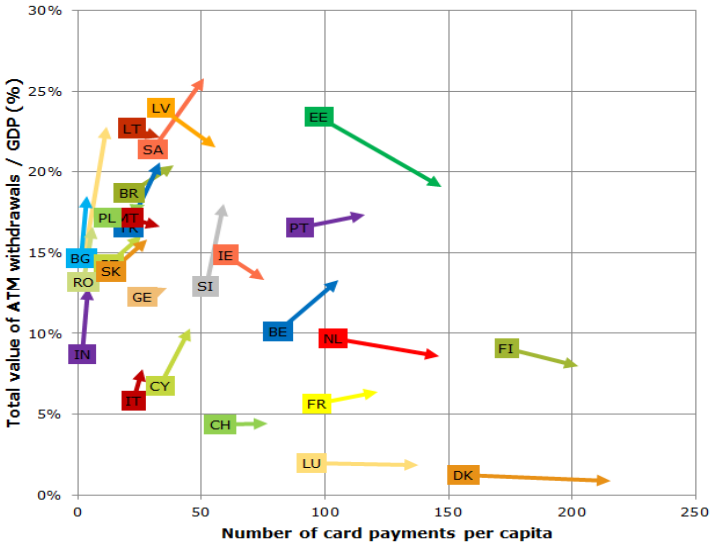
Figure 1.2: Evolution of global number of non-cash transactions (2005 - 2011)



Note: This figure presents the total annual number of non-cash transactions made in the euro area and in the CPSS countries from 2005 to 2011 (dark green line), as well as a breakdown by payment instrument (coloured bars). Data are taken from the ECB Statistical Data Warehouse, the BIS Red Book and the Federal Reserve Board.

The latest trends indicate a global shift towards electronic payments, and there are various signs that this goes at the expense of the paper-based instruments, both at the POS and for remote transactions. Clearly, on a global level, the use of cheques has declined with the growth in credit transfer and direct debit transactions (see Figure 1.2). For POS payments, a similar shift away from paper is visible. Amromin and Chakravorti (2009), for example, find that greater use of debit cards has resulted in lower demand for small-denomination banknotes and coins. This suggests that payment cards are increasingly used as a substitute for cash. A similar conclusion can be drawn from Figure 1.3, which shows that the total value of ATM cash withdrawals relative to a country's Gross Domestic Product (GDP) has significantly decreased in countries where cards are heavily

Figure 1.3: Evolution of card payments and ATM cash withdrawals



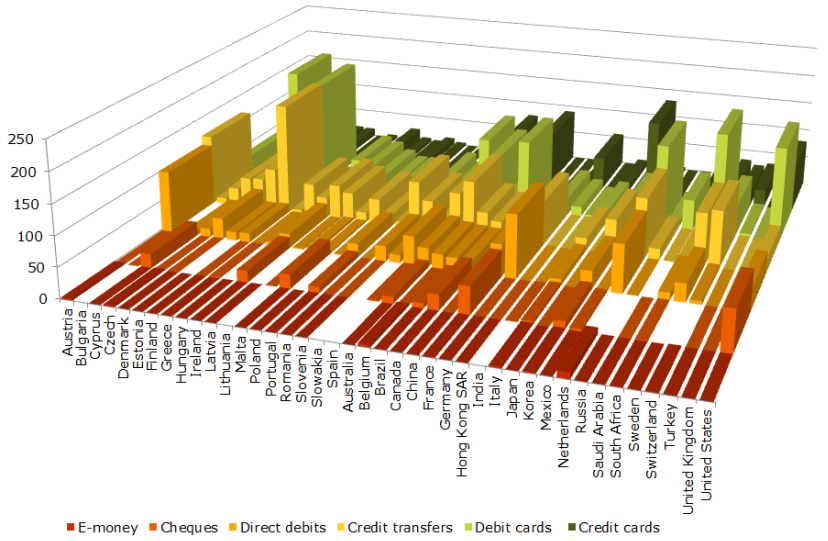
Note: This figure shows the development of total card payments per capita and the total value of ATM cash withdrawals/GDP for various euro area and CPSS countries between 2007 (squared cubes) and 2011 (arrow points). Data are taken from the ECB Statistical Data Warehouse and the BIS Red Book.

used. However, Figure 1.3 also demonstrates that it may take some time before the proliferation of payment cards starts to result in a decrease in cash usage. In fact, it shows that in countries where card usage is relatively low, the growth in card payments coincides with an increase in ATM use. This positive effect of card usage on cash withdrawals most likely reflects a change in withdrawal behaviour, with consumers shifting away from manually withdrawing cash at bank branches to using ATMs as soon as they become more familiar with using a payment card. Once the annual number of card payments per capita reaches 100, the increase in card usage starts to go at the expense of cash.

Despite the global digitisation of retail payments, habits significantly differ across the world. Due to particular country characteristics, such as

differences in available instruments, efficiency, preferences, ICT development, concentration of suppliers, financial incentives and legal and regulatory frameworks, each country has its own payment profile (CPSS (1999)). Some are more cash or cheque-oriented, while others have largely moved over to paperless and electronic instruments. In Europe, for example, the proportion of cash in total payments ranges from 27% in Sweden up to 95% in Greece (Schmiedel et al. (2013)). Also, the use of cards is unequal across countries (see Figure 1.4). The northern European countries, for instance, are characterised by relatively high debit card use, whereas credit cards are relatively often used in Canada, the United States, Australia and some Asian countries. The usage of cheques also greatly varies across the

Figure 1.4: Annual number of non-cash transactions per capita, by country (2011)



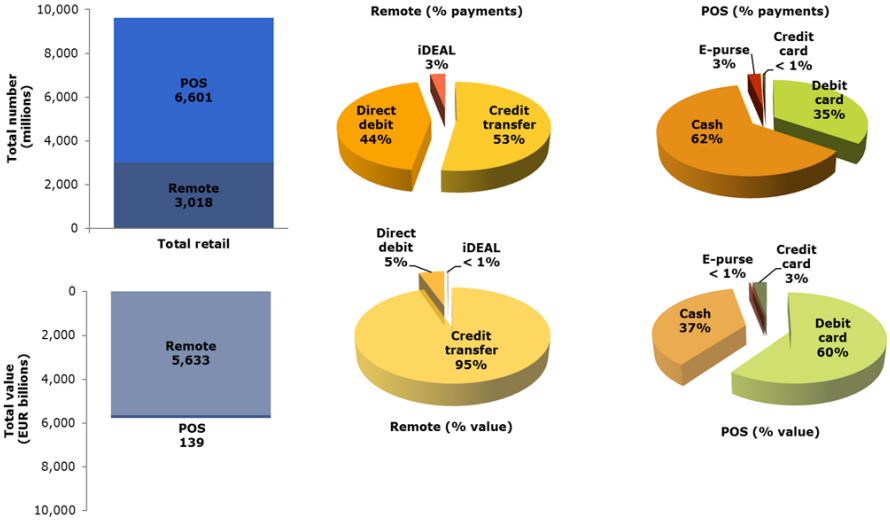
Note: This figure presents the total number of non-cash transactions made per capita by payment instrument in various euro area and CPSS countries in 2011. Data are taken from the ECB Statistical Data Warehouse, the BIS Red Book and the Federal Reserve Board.

world. In some countries, such as the Netherlands and Hungary, they are no longer in use, whereas they still account for around 20% of all non-cash transactions in the United States and France.

1.2.4 Retail payments in the Netherlands

Each country is unique, so is the Netherlands. In 2011, total retail payments amounted up to 9.6 billion transactions with a total value of EUR 5,771 billion (see Figure 1.5). Due to the rapid growth in debit card usage, the Netherlands is now ranked among those with the greatest share

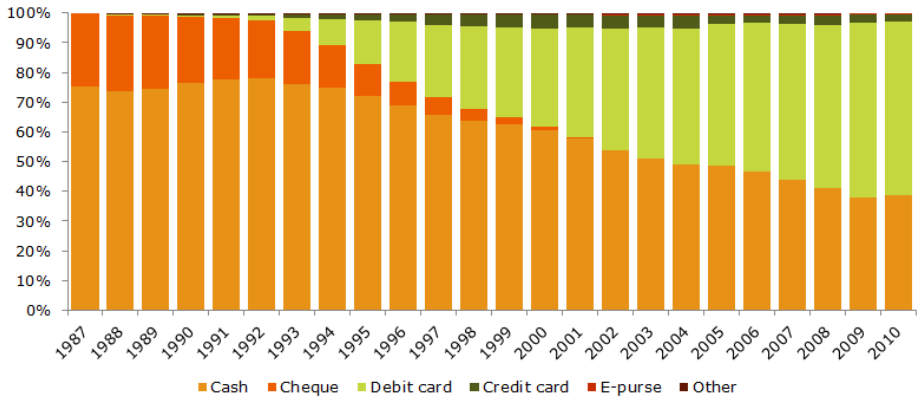
Figure 1.5: Total number and value of retail transactions in the Netherlands (2011)



Note: This figure presents the total number (upper bar) and value (lower bar) of retail payments in the Netherlands in 2011, as well as a percentage breakdown of total POS and remote transactions (upper pies) and total POS and remote value (lower pies) by payment instrument. Cash shares are calculated using estimates provided by DNB (DNB (2012)). Non-cash shares are calculated using retail payment statistics supplied by banks, Currence and credit card companies.

of debit cards in total non-cash payments (see Figure 1.4). The card was introduced in the late 1980s. By then, POS transactions were either paid by cash or by cheque (see Figure 1.6). Initially, the debit card was mainly used for withdrawing money at ATMs, but in the early 1990s a few large retailers started to accept debit cards and soon the number of card payments increased, which further spurred the availability of terminals at other POSs. Since then, the card has rapidly grown into a widely used means of payment. This strong growth elicited a gradual fall in the usage of both cash and cheques. At the time of the euro change over in 2002, the use of cheques had fallen to such a low level that banks decided not to convert them to euro-denominated cheques, as a result of which they were no longer provided to the market. In the following years, the on-going growth in card payments entirely went at the expense of cash. About 20 years after its introduction, the debit card has notably surpassed cash as the major payment instrument used at the POS in terms of value. In fact, in 2011, 60%

Figure 1.6: Evolution of total value of POS payments in the Netherlands (1987 - 2010)



Note: This figure presents the percentage shares of cash, cheques, debit cards, credit cards, the e-purse and other payment instruments in total POS value from 1987 to 2010. Data are calculated using consumption data provided by Statistics Netherlands and non-cash retail payment statistics supplied by banks, Currence and credit card companies.

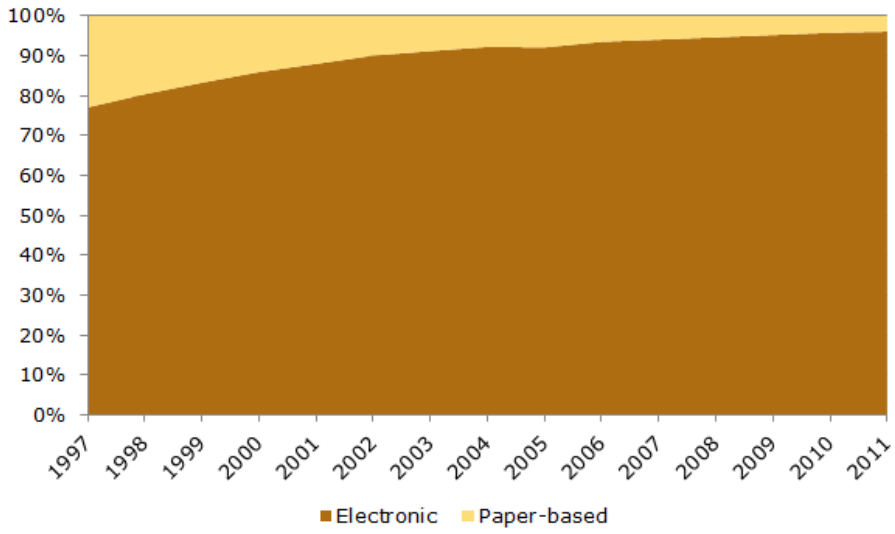
of total POS sales was paid by debit card versus 37% in cash. In terms of numbers, however, the majority (62%) is still paid in cash (see Figure 1.5). So, despite the on-going growth in debit card payments, there is still room for further substitution.

Total POS transactions in the Netherlands are clearly dominated by cash and debit cards. Credit cards as well as the e-purse product Chipknip[5] are rarely used. Together they represent a share of about 3% in total POS transactions (see Figure 1.5). The limited willingness among retailers and consumers to adopt and to use them may be explained by their limited added value over the existing means of payment. Chipknip was introduced by a group of banks in 1996 as an electronic alternative for small cash payments. Until 2002, however, it had to compete with Chipper, another e-purse system supplied by another bank. The co-existence of two incompatible infrastructures hampered their uptake by retailers. It was only in 2002, when the banks decided to set Chipknip as the standard, that various merchants started to accept Chipknip transactions. However, soon after, the merchants' costs of debit card payments started to decrease, which rapidly diminished the cost advantages of the e-purse. At the same time, the limited acceptance, as well as the burden of uploading the e-purse with sufficient balances, reduced the willingness of consumers to use it (CPSS (2012)). Similarly, up till now the credit card has not fulfilled a specific demand from consumers. Its main distinctive characteristic is the ability to delay the payment or to buy on credit. However, this is an attribute that the Dutch hardly value. Research has shown that buying on tick is not in their nature (Kosse (2009)). Due to this limited consumer demand, together with its relatively high merchant fees, its acceptance among retailers has remained limited as well. As a result, the Dutch mainly use a credit card for paying abroad and online when debit cards are not accepted.

[5]The e-purse product Chipknip is a smartcard-based prepaid instrument that provides instant and irrevocable offline transactions at the POS. The chip embedded into the card can be uploaded at special terminals with a maximum of EUR 500. Since Chipknip transactions do not require a PIN, the e-purse is mainly used for low value payments.

Regarding remote payments, the vast majority, i.e. 53% in total numbers and 95% in total value, is paid via credit transfers. Direct debits are heavily used in the Netherlands as well, accounting for 44% of transactions and 5% in value. There is a clear trend away from paper towards electronics (see Figure 1.7). Credit transfers are increasingly initiated electronically and the use of direct debits clearly exhibits a steady increasing trend. Moreover, since its introduction in 2005, the online-banking based payment scheme iDEAL has grown into the main payment instrument used for online purchases. In 2011, it represented a market share of 3% in total remote payments (see Figure 1.5).

Figure 1.7: Evolution of total remote payments in the Netherlands (1997 - 2011)



Note: This figure presents the percentage shares of electronic and paper-based instruments used in total remote transactions from 1997 to 2011. Paper-based remote payments represent all funds transfers initiated via a paper form or a giro collection form (Acceptgiro). Calculations are based on non-cash retail payment statistics supplied by banks, Currence and credit card companies.

1.2.5 Social costs of retail payments

Earlier research demonstrates that 'payments are no free lunch' (see CPSS (2012) and Schmiedel et al. (2013) and references therein). All participants along the retail payments chain, such as banks, central banks, interbank infrastructures, businesses, retailers and consumers, incur costs so to enable retail payments to be made and received. The private costs of each participant consist of the costs incurred by these agents themselves, i.e. their internal costs, and the fees paid to others, i.e. their external costs. The private costs for central banks comprise, among others, the costs of designing and printing banknotes, minting coins, storage and transportation, as well as the costs of combating counterfeiting. The banking sector also makes costs for facilitating cash usage, such as costs related to the operation of ATMs and the handling and processing of cash deposits made at local branches. Banks incur costs for electronic payment instruments too, such as processing costs and costs related to fraud losses and fraud prevention. Retailers' private costs include, among others, the costs of POS terminals and cash registers, security and fraud costs, as well as the time necessary for counting banknotes and coins, and for packaging and transporting it to the bank. In addition, retailers and other businesses often pay fixed periodic fees and transaction fees for withdrawing and depositing cash and for accepting and making electronic payments. Important cost elements for consumers include the time spent for making payments or cash withdrawals, the losses and risks of holding and using payment instruments, and fees paid, for example, for withdrawing cash or holding a payment card.[6]

In order to put the costs of retail payments into perspective, they are often related to a country's GDP. According to Humphrey (2010), the total annual costs of a retail payment system may approach 1% to 2% of GDP. In the Netherlands, the private costs of POS payments for retailers are estimated at 0.22% of GDP (EIM (2011)) and for banks at 0.78% of

[6]See Jonker (2013) and Schmiedel et al. (2013) for a detailed description of the costs incurred by the various participants for making and receiving payments.

GDP (McKinsey&Company (2006)). Similarly, the private costs of banks are estimated at 0.49% of GDP in Norway (Gresvik and Øwre (2003)) and at 0.77% of GDP in Portugal (Banco de Portugal (2007)).

A significant number of contributions shed light on the social costs of retail payments, i.e. the total costs for society as a whole.[7] Social costs differ from private costs in that they do not refer to fees paid between participants, as these fees are a cost for the one but a revenue for the other. Therefore, the total costs to society equal the sum of the internal costs of all participants only, and hence measure the pure resource costs to the economy. Schmiedel et al. (2013) estimate the total social costs of retail payment instruments in the EU27 in 2009 at EUR 130 billion, equivalent to almost 1% of GDP or EUR 260 per inhabitant.

Due to their specific characteristics, each individual payment instrument carries a different cost to society. Also, the social costs of payment instruments depend on the features of the respective payment markets, e.g. in terms of available payment infrastructures and the maturity and size of the non-cash markets. Therefore, the unit social costs, i.e. the social costs per transaction, significantly differ between countries. Within Europe, for instance, the unit social costs of cash vary between EUR 0.13 and EUR 0.78 per transaction, while those of a debit card payment range between EUR 0.18 and EUR 3.40. As a result, in some countries cash carries the lowest unit social cost, whereas in others, such as in the Netherlands, debit card transactions are cheapest. In all countries, cheques and credit cards are found to be most costly to society, with the average social costs of a cheque payment varying between EUR 2.39 and EUR 6.10 and those of a credit card transaction ranging between EUR 0.48 and EUR 8.65 (Schmiedel et al. (2013)).

As each payment instrument carries a different social cost, the payment choices made by consumers and businesses are not without effect. How-

[7] The many references include Denmarks Nationalbank (2012), Turján, Divéki, Keszy-Harmath, Kóczán and Takács (2011), Takala and Viren (2008), Banque Nationale de Belgique (2005), Jonker (2013), Gresvik and Haare (2008), Segendorf and Jansson (2012).

ever, in order to assess which payment instrument is most cost efficient and to be preferred from a social point of view, the unit social costs are not an appropriate indicator, as they are the outcome of the current number and value of transactions made. Instead, as described in Jonker (2013), one should consider the costs of one additional transaction. These variable costs differ by transaction value. Hence, for some transaction amounts one payment instrument may be most efficient, while for other amounts another one may be preferred. Various studies have estimated the so-called 'break-even point' between cash and debit cards, i.e. the transaction value above which the variable social costs of an additional cash payment exceed those of a debit card payment. Overall, the debit card is found to be more cost efficient from a social point of view than cash, except for the smallest transactions.[8]

Yet, what is most cost efficient for society, may not be most attractive from the consumers' or businesses' point of view. For them it is their private costs that matter. As a result, the payment instrument that is most cost efficient for society may in practice not be widely used if one or more market participants perceive its private costs as too high. Instead, they will prefer to use the instrument that carries the lowest private costs. Hence, a discrepancy between private costs and social costs may lead to an overuse of socially inefficient payment instruments.[9] In many countries over the world, consumers are only charged a fixed fee for using a bank account, without being confronted with transaction fees for each transaction they make (e.g. Guibourg and Segendorf (2007), Evans (2011), Jonker (2013)). As a result, they are often unaware of the social costs of their choices and they receive no financial incentives towards more socially ef-

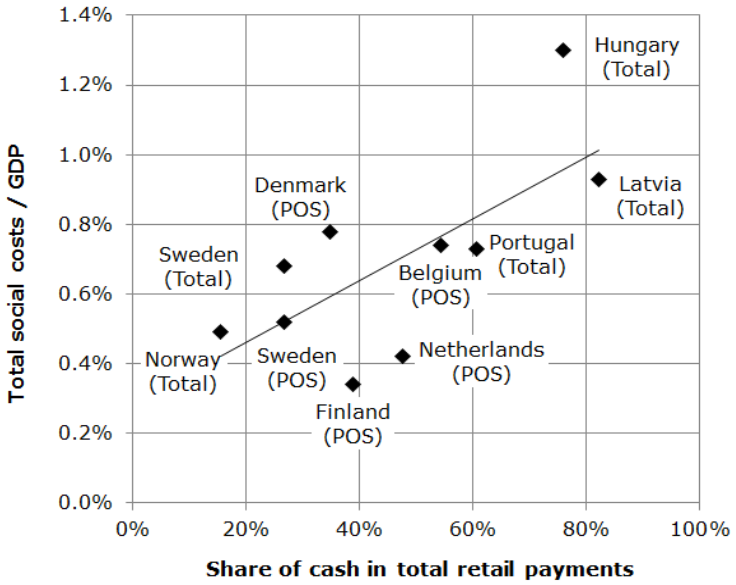
[8]The break-even point between cash and debit card payments for Denmark, Sweden and the Netherlands in 2009 is estimated at EUR 3.90, EUR 1.88 and EUR 3.06 respectively (Denmarks Nationalbank (2012), Segendorf and Jansson (2012), Jonker (2013)).

[9]Jonker (2013) shows that in the Netherlands, the relative private costs of cash and debit cards for banks and retailers reflect their relative social costs. For both participants, the average private costs of cash are higher than those of debit card payments. As a result, the private interests of banks and retailers generally correspond to the social interest.

ficient behaviour. Given their relatively high social costs, this may have lead, at least from a social perspective, to an overuse of cash and other paper-based instruments.

Owing to the increased awareness among banks and businesses of the costs of paying, various initiatives have been taken, either on an individual or a cooperative basis, in search of cost reductions. The intended cost savings basically stem from two different sources. First, attempts have been made to realise savings along the payments chains, for example by automation of manual payment processes (Leinonen (2008)), rationalisation of networks of branches (Humphrey, Willesson, Bergendahl and Lindblom (2006)), or rearrangements of tasks and duties in the cash cycle (Binnekamp (2011)). Second, reducing social costs by changing the use of payment instruments has become a major theme. There is general consensus that a further replacement of cash and manual payment transactions by electronic payments would foster the social cost efficiency of a payment system. Different steps have been taken by banks and businesses in order to steer consumers in this direction, for example by launching new electronic payment instruments (CPSS (2012)), through public information campaigns (Jonker (2013)), by introducing consumer transaction fees for ATM withdrawals (Flood, Hancock and Smith (2011)) or by removing POS debit card surcharges (Bolt (2013)). Estimates show that the social cost savings yielded by moving from paper-based to electronic systems and instruments may vary between 0.25% to more than 1% of GDP (Humphrey et al. (2003), DCITA (2006)). Evidence from Europe indeed provides some indications that the social costs of paying are relatively low in countries that are characterised by high levels of digitisation (see Figure 1.8). Although both electronic and paper-based means of payment also offer benefits in terms of convenience, anonymity or accessibility, it is the strive for higher social cost efficiency that constitutes one of the main drivers behind the current global trend towards further digitisation (CPSS (2012)).

Figure 1.8: Cash usage and social costs of retail payments



Note: This figure presents the percentage shares of cash in total retail payments as well as the total social costs as a percentage of GDP for various countries. The diagonal line is a trend line reflecting the overall direction of the data. The scope of the social costs is indicated between parentheses: the costs for Hungary, Portugal, Latvia and Norway refer to the costs of total retail payments, whereas the costs for Denmark, the Netherlands, Finland and Belgium refer to POS payments only. For Sweden both estimates are presented. Sources: Schmiedel et al. (2013), Gresvik and Haare (2008), Banque Nationale de Belgique (2005) and Latvijas Banka (2013).

1.2.6 Economic features of retail payment markets

Switching an economy's payment behaviour towards the use of electronic payment instruments in order to reduce total social costs is not easy and requires a change among both the supply side (e.g. banks, processors and other providers) and the demand side (e.g. consumers, retailers and businesses). The particular economic features of retail payment markets, i.e. the concepts of economies of scale and scope, network externalities and two-sided markets, play an important role here.

First, banks and other payment service providers will need to have a valid business case to launch and to stimulate the use of electronic means of payment. In general, they will only do so if it allows them to improve revenues or to reduce costs. Providing electronic payment instruments typically involves high fixed investment costs. The marginal costs of producing one single electronic transaction, however, are small. As a result, considerable economies of scale can be achieved, as the average costs of producing a payment decrease as soon as the number of transactions increases (e.g. Bolt and Chakravorti (2012)). In addition, scope economies can be achieved, as the average costs per transaction decline when using the same infrastructure for different payment instruments. Due to these economies of scale and scope, the willingness among suppliers to provide electronic instruments strongly depends on whether they will be able to process a large number of transactions. This is one of the explanations of why successful payment innovations have often been characterised by a high degree of standardisation and cooperation between suppliers (CPSS (2012)). Establishing cooperation, however, is not easy, in particular in case of a large number of suppliers. Hence, the presence of economies of scale and scope may hamper the development and supply of electronic payment instruments. In addition, it may lead to what is called 'path dependence', where the decision to invest in new instruments depends on the history of previous investments. Suppliers who have made significant investments in the past and who have been able to reap large economies of scale will have different incentives to re-invest in new instruments than suppliers who have made no past investments (e.g. Evans and Schmalensee (2009)). As a result, countries with an underdeveloped payment infrastructure may have relatively high potential for adopting new electronic payment solutions (CPSS (2012)).

Second, realising change in retail payment markets is complex due to the presence of network externalities. These externalities derive from the fact that the value of using a particular instrument depends on the number of other people using it. Consequently, payment instruments will only take

off in case there is a minimum number of users, which is often referred to as a 'critical mass'. This is a second explanation for the high degree of cooperation between banks in retail payment markets, as it enables bank customers to make and to receive payments to and from customers of other banks. There is a vast amount of literature on network externalities arising in other markets, such as in the telephone and railway industry (e.g. Katz and Shapiro (1986) and Farrell and Klemperer (2003) and references therein). It is generally acknowledged that the presence of network externalities may hinder the move towards new products or standards, as it requires all suppliers to move together. As mentioned above, coordinating such a joint move is not easy, in particular in case of a large number of suppliers. A lack of coordination may delay or prevent a move to more efficient standards, which may lead to problems of excess inertia, i.e. a lock-in to inferior products. This may explain why diffusion of new payment technologies is more likely in countries with highly concentrated banking systems (Milne (2006)).

Readiness and coordination of the supply side of the market, however, is not enough for changing an economy's payment behaviour. It also requires a behavioural change among the users, i.e. the payers and payees. Consumers and businesses need to have clear incentives to adopt new behaviour. Incentives for change are typically lower costs, higher speed, better security or improved ease of use (CPSS (2012)). However, as discussed in Berger, Hancock and Marquardt (1996), consumers and businesses may take a long time to make widespread use of new instruments because of various reasons, such as learning costs and lack of familiarity. Also, adoption of new payment instruments may require substantial switching costs, such as costs of re-investing in new software, devices or training (Farrell and Klemperer (2003)). As a result, consumers and businesses may find it too expensive to switch to new ways of paying.

The presence of network externalities may also prevent the demand side from changing its behaviour. That is, consumers and businesses will only

adopt a new instrument if sufficient other users do the same. Achieving such a critical mass of movers is particularly difficult due to the two-sided character of the retail payment market.[10] With the exception of payments between consumers (P2P payments) and between businesses (B2B payments), the majority of transactions involve two different types of users, i.e. consumers and businesses. Because of this, the major challenge lies in achieving a critical mass on both sides, which is often compared to the 'chicken-and-egg' dilemma. That is, consumers only want to adopt a given instrument if it is accepted by a sufficient number of merchants or businesses. Similarly, merchants and businesses only want to accept it if enough consumers are able and willing to pay with it. A commonly used approach in two-sided industries is to apply different prices for both sides, with the least price-sensitive side subsidising the other one (e.g. Evans (2003) and Bolt and Chakravorti (2008b)). This may explain why most payment systems around the world apply a merchant-pays rather than a consumer-pays model, where consumers are only charged a fixed fee for adopting a payment instrument and no transaction fees. By contrast, merchants and businesses are often charged through fees that are directly linked to the number and value of transactions received and made (e.g. Guibourg and Segendorf (2007), Evans (2011), Jonker (2013)).

1.3 Factors driving consumer payment choice

There is a vast amount of literature on the process of diffusion, i.e. the process by which consumers adopt new products over time. The theory of diffusion of innovations (see Rogers (2003)) is based on the general idea that each consumer has his or her own preferences, due to which the adoption of new technologies typically follows an 'S' curve. In the beginning, when a new technology is launched, it is only adopted by a small group of so-called 'early adopters'. Subsequently, its adoption gradually increases

[10] For a review of the academic literature on two-sided payment networks, see Bolt and Chakravorti (2008b).

until it reaches the acceptance stage, i.e. the stage when the rate of adoption accelerates. Finally, the innovation matures and its rate of adoption slows down until its saturation point. The diffusion of debit cards in the Netherlands as depicted in Figure 1.6 indeed seems to follow an 'S' curve. Currently, the market appears to have passed through the acceptance stage and to have entered the maturity stage. Yet, there is still room for further growth. That is, although 98% of Dutch consumers own a debit card and 100% of supermarkets accept them, still around 55% of all supermarket payments are made in cash (Kosse and Plooij (2011), HBD (2011), DNB (2012)). This suggests that consumers clearly use a mixture of different instruments, which is not only to be explained by levels of debit card adoption and acceptance. Hence, there seems to be an important role for other factors as well.

While there is a large amount of theoretical literature on pricing and competition in retail payment markets (e.g. Bolt and Chakravorti (2008b)), the current literature on consumers' use of retail payment instruments is mainly empirical. It departs from the idea of heterogeneous consumer preferences and different product attributes. Each payment instrument differs from others in terms of costs, as well as benefits, such as speed, ease of use, safety and anonymity. At the same time, each consumer has his or her own preferences and attaches a different importance to each of these attributes. In the end, the choice which payment instrument to use is assumed to be based on the net benefits derived from it.

Some papers have studied consumers' payment behaviour over time using aggregate data supplied by payment systems and industry sources (e.g. Humphrey, Pulley and Vesala (1996), Jonker and Kettenis (2007), Bolt, Humphrey and Uittenbogaard (2008), Amromin and Chakravorti (2009)). Overall, they find a strong impact of the availability of POS and ATM terminals and the number of bank branches on the use of cash and cards. Other macro-economic factors, such as short-term interest rates, are concluded to be less effective in explaining consumers' payment behaviour.

The majority of papers studying consumers' payment behaviour have taken a micro perspective. Due to a lack of accurate transaction data, most of them are based on self-reported survey data.[11] Only a few studies have been able to use transaction data provided by banks, grocery stores or credit card companies (e.g. Rysman (2007) and Klee (2008)). Overall, consumer payment choices are concluded to be influenced by consumer, transaction, situational as well as payment method characteristics.

First, consumer characteristics are relevant. A common finding is that younger, more educated consumers with higher incomes are more likely to use electronic payment instruments, both at the POS and in remote payments. By contrast, the elderly, consumers who have received less education and those with lower incomes are more prone to using cash or other paper-based instruments. The rationale is that young and more educated people are more open to new technologies and that young people lack the history of using paper-based instruments. Moreover, educated and high-income people have higher opportunity costs and dislike the greater amount of time it takes to initiate paper-based versus electronic transactions (Kennickell and Kwast (1997), Humphrey, Kim and Vale (2001). Some studies find a role for gender, with women being more likely than men to use electronic payment media. Furthermore, the probability of paying by cards instead of cash is found to decrease with the urbanisation degree of consumers' living environment (Jonker (2007)), which might reflect the role of adoption and acceptance-related determinants, such as the regional density of ATMs and POS terminals. Finally, consumers' attitudes towards electronic technologies in general seem to play a role as well. Consumers who regularly use the internet, computers or other new technologies are more likely to pay electronically (Hayashi and Klee (2003), Schuh and Stavins (2010)).

[11] The many relevant references include Kennickell and Kwast (1997), Boeschoten (1998), Mantel (2000), Yin and DeVaney (2001), Stavins (2001), Hayashi and Klee (2003), Bounie and François (2006), Jonker (2007), Borzekowski, Kiser and Ahmed (2008), Borzekowski and Kiser (2008), Hyytinen and Takalo (2009), von Kalckreuth, Schmidt and Stix (2009), Zinman (2009), Ching and Hayashi (2010), Schuh and Stavins (2010).

Second, payment choices are found to depend on transaction characteristics. In particular, the size of the transaction is a major determinant of consumers' payment choice at the POS, with higher transaction amounts being more likely to be paid by card instead of cash and cash being highly preferred for low value transactions (e.g. Boeschoten (1998), Bounie and François (2006), Jonker (2007), Klee (2008), von Kalckreuth et al. (2009)).

Third, situation and location matter. For instance, Bounie and François (2006) and Jonker (2007) show that payment choices differ according to the type of merchant. This might reflect the different levels of penetration of payment terminals across stores and sectors. Rysman (2007), for example, demonstrates that consumers' choices which instrument to use are highly correlated with the degree to which particular payment instruments are accepted. Also, the absence of a cashier, e.g. at vending machines, is found to affect payment choices. Usually, unattended payment locations increase the probability of a cash payment (Hayashi and Klee (2003)). In addition, financial as well as non-financial incentives play a role. Bolt, Jonker and Renselaar (2010), Barron, Staten and Umbeck (1992), Amromin, Jankowski and Porter (2007) and Chakravorti (2010) demonstrate that consumers react strongly to transaction charges and to discounts imposed by retailers for particular payment instruments.

Fourth, consumer payment choices are found to be influenced by payment instrument-related characteristics (either real or perceived), such as the transaction speed, ease of use, anonymity and the ability to control and keep record of expenses. In general, consumers with greater preferences for convenience and speed are more likely to prefer electronic instruments over their paper-based counterparts (e.g. Mantel (2000), Borzekowski et al. (2008), Schuh and Stavins (2010)), whereas the desire for privacy and budget control is driving consumers towards cash (e.g. Jonker (2007), von Kalckreuth, Schmidt and Stix (2011)). Also, there is growing evidence that bank-imposed transaction fees cause consumers to shift towards less costly payment instruments, while reward programs have a positive

effect on the usage of instruments (e.g. Humphrey et al. (2001), Bolt et al. (2008), Borzekowski et al. (2008), Zinman (2009), Ching and Hayashi (2010), Sprenger and Stavins (2012), Arango, Huynh and Sabetti (2011), Carbó-Valverde and Liñares Zegarra (2011)).

1.4 Research topics in consumer payment choice

Despite the large amount of available research, there are several topics that are highly relevant in understanding consumers' choices between payment instruments and that await further empirical exploration. In particular, this thesis centres on the following research topics: (i) the role of a consumer's foreign background, and (ii) the role of payments fraud and safety risks. Before introducing the general objective and research question of this thesis, this section first provides a general description of these two research topics.

1.4.1 The role of a consumer's foreign background

The payments literature has so far paid little attention to payments of consumers having a foreign background, i.e. consumers whose parents are born abroad. The major explanation is that they are usually underrepresented in consumer surveys due to the complexity and high costs of reaching and approaching them. Also, the rate of response is often quite low (Schmeets and van der Bie (2006)). Yet, residents with a foreign background make up a considerable share of the population in many countries. In the Netherlands, for instance, around 20% of the Dutch population have a foreign background,[12] and in the United States and Australia they account for 14% and 26% of the population (World Bank (2011)). Given the significant importance of these population groups, as well as the effect that payment choices have on the total social costs of an economy, more insight is desired into their payment choices. These choices may differ from those made by

[12]This estimate by Statistics Netherlands refers to the Dutch population of 15 years and older in 2008 of which at least one of the parents is not born in the Netherlands.

the native population. Migrant groups generally have ties - either directly or through their parents - to countries where payment habits differ substantially from those in the host country, and these home-country habits may influence their behaviour after migration. There are a few studies that report differences in payment behaviour based on race and ethnicity (e.g. Borzekowski and Kiser (2008), Borzekowski et al. (2008), Ching and Hayashi (2010), Schuh and Stavins (2010), Mann (2011)). However, these papers do not have detailed information on respondents' country of origin or generation. In other research fields, the role of foreign backgrounds has been studied more extensively. In the area of migrant participation in financial service or labour markets, for example, there is evidence that the culture in the home country influences behaviour of immigrants in host countries (e.g. Osili and Paulson (2009), Jankowski, Porter and Rice (2007)) and that home-country effects vanish over time, with second-generation migrants being more influenced by the host-country's culture (Kok, Bosch, Deelen and Euwals (2011)). To what extent similar dynamics are present in consumers' payment choices is still unclear and deserves further exploration. Having insight into the payment choices made by people with a foreign background is relevant for answering the question whether there is room for a further increase in the use of electronic payment instruments. In particular, insight into the effect of home-country habits and generation is important, as it allows for a better understanding of the underlying reasons of consumers' choices, and, hence, of what potential measures to take to stimulate electronic ways of paying.

1.4.2 The role of payments fraud and safety risks

The global trend towards digitisation of retail payments has not only created opportunities in terms of social cost savings and improved user satisfaction; it has also brought in new types of safety risks. The on-going increase in the acceptance and usage of electronic payment instruments has made them increasingly attractive for fraud. In particular, card fraud has become

a serious threat. Statistics on global card fraud are not available, but estimates are reported of EUR 1,500 million for the European Union in 2011 (Europol (2012)). In particular over the past 10 years, countries have been facing a strong increase in skimming fraud, where the data on the magnetic stripe is copied and the PIN is captured so to produce counterfeit cards. In the Netherlands, total skimming fraud has increased from less than EUR 4 million in 2005 to EUR 29 million in 2012.[13] Until now, total fraud losses are still relatively small compared to the size of the electronic payments market. Moreover, overall, electronic payment instruments are still found to be less costly to society than their paper-based counterparts. Nevertheless, the overall societal consequences could be more widespread. Due to personal experiences and increasing media attention, consumers may lose their confidence in paying electronically and shift to alternative ways of paying that carry a higher cost to society, which would eventually affect the overall cost efficiency of the retail payment system. In this light, it is important to have a clear understanding of how consumers assess the safety of payment instruments and of how this affects their payment choices. Yet, research into this topic is scarce and does not reach a unanimous conclusion. Several theories and findings suggest that safety is one of the factors considered when choosing how to pay (Bolt and Chakravorti (2008a), He, Huang and Wright (2008), Humphrey et al. (1996), Jonker (2007), Alvarez and Lippi (2009), Borzekowski et al. (2008), Kahn and Roberds (2009), Arango and Taylor (2009), Kahn and Liñares Zegarra (2012)). Others, however, find no evidence of safety playing an important role (e.g. Yin and DeVaney (2001), Ching and Hayashi (2010), Schuh and Stavins (2010)). Moreover, the impact of media reports about payments fraud and risks has not been studied at all. Therefore, there is considerable room for further research so to provide insight into the extent to which consumer confidence and payment choices are affected by payments fraud and safety risks. This insight is relevant for understanding whether safety and fraud currently

[13]Information provided by the Dutch Banking Association.

hinder a further growth in the use of electronic payment instruments or whether they may do so in the near future. In addition, it allows for a better understanding of how to further stimulate electronic ways of paying.

1.5 General objective and focus

1.5.1 General theme and research question

Given the background provided above, the main objective of this thesis is to further examine the motives and mechanisms underlying consumers' choice between payment instruments. More specifically, the main research question is *"How are consumer payment choices influenced by foreign backgrounds and payments safety?"*. By empirically investigating the role of these under-exposed factors, this thesis sheds light on the question of whether and how the use of electronic payment instruments can be further increased, i.e. whether there is room for further digitisation. This is a relevant question as a further shift towards electronics may foster the social cost efficiency of a payment system.

Having accurate data on the usage of the different payment instruments is key to examining the drivers underneath. As, unlike non-cash payments, actual data on cash payments are lacking, before turning to the main research question, we first take one step back by empirically examining *"What is the best methodology to estimate the number of cash transactions made by consumers?"*.

1.5.2 Focus and general applicability

In order to answer the main research question with sufficient depth, a focus is taken on the major payment choice made by Dutch consumers; the choice between cash and debit cards at the point-of-sale (POS). Also, when examining what research methodology is most suited to estimate the number of cash payments, Dutch POS payments data are employed. The facts that nearly all inhabitants have a debit card and that 97% of all POS transac-

tions are paid by either cash or debit make the Netherlands an interesting country to look at, as everyone is able to use cash and a debit card, and as the use of alternative means of payment is limited. This provides a good basis for analysing the drivers behind the trade-offs made between cash on the one hand and its electronic counterpart on the other.

Given its focus, this thesis will not provide an answer to the question of how and why Dutch payment habits vary from those in other countries. That is, country specific factors, such as the availability and characteristics of alternative instruments, national programmes to stimulate particular behaviour, and general levels of security, for example, may all affect the trade-offs made when deciding how to pay, and hence cause behaviour and drivers to differ. Second, by limiting itself to the cash - debit card trade-off only, no conclusions will be drawn about the drivers underneath the choice between cash and credit, or between credit and debit. Differences may be expected, since the credit facility introduces an additional attribute into the decision process, which may alter the weights attached by consumers to safety and to the other payment attributes.

Yet, the conclusions of this thesis may have wider applicability in explaining consumer payment choices. The trade-offs made by the Dutch are likely to be comparable to those in countries that display similar payment habits, such as in Denmark, Sweden and Finland that are also characterised by relatively high debit card usage and low (or no) credit card and cheque usage. Moreover, the motives underneath Dutch consumers' POS behaviour may be comparable to the drivers of their remote payment choices. Zinman (2009) and Ching and Hayashi (2010), for instance, show that people who frequently use electronic instruments for transferring funds are more likely to pay electronically at the POS as well.

1.6 Contributions

In order to answer its research question, this thesis contains four empirical chapters, each of which makes use of work that has been published in a peer-reviewed journal. Chapter 2 is based on Jonker and Kosse (2013), Chapter 3 makes use of the work in Kosse and Jansen (2013), and Chapter 4 and Chapter 5 are based on Kosse (2013b) and Kosse (2013a). For the purpose of this thesis, where relevant, the texts of these publications have been rearranged or slightly rewritten and some analyses have been adjusted. This section presents an overview of the four chapters, including their objectives, methodologies used and their contribution to the literature.

1.6.1 Chapter 2: Measuring payment choices: the impact of survey design on cash estimates

Unlike non-cash payments, cash payments are characterised by their anonymous nature. As a result, actual data on the total number and characteristics of cash payments are lacking. This is an important barrier to the measurement of the level and speed of digitisation in retail payment markets, as well as of the underlying drivers of consumers' payment choices and the associated payment costs. The total value of cash in circulation and the value of cash withdrawals, as well as transaction records from large retailers are often used as indicators of consumers' use of cash. Yet, these statistics are mainly indicative of the total cash value used, and do not provide insight into the number and nature of individual cash payments. Therefore, the most common approach in payments research to measure the number and nature of cash transactions has been to estimate it using surveys among samples of consumers. This, however, asks for a sound survey methodology as sample-based surveys are typically sensitive to errors that may cause results to deviate from reality.

Although various studies have been conducted on the size and nature of survey errors in health, expenditure and income research (e.g. Ahmed,

Brzozowski and Crossley (2006), Gibson and Kim (2007), Estelami and Lehmann (2001), Lynn, Jäckle, Jenkins and Sala (2012)), there is no clarity about the survey errors arising in payments research. A comparison of different cash estimates, however, does indicate that survey errors are clearly present. In the Netherlands, for instance, annual cash estimates for the year 2003 range from 2.8 billion (Currence (2005-2007)) to 7.6 billion transactions (TNS Nipo (2003)). These studies greatly vary in survey methods used, and thus point to an important role of survey design. What methodology is most accurate, however, has still remained unclear. Against this background, before turning to the main question of this thesis, the objective of Chapter 2 is to assess what is the best way to measure the number and nature of cash payments made by consumers. Having insight into the use of cash at such a detailed level is important for understanding consumers' motivations for using cash. This allows for a better understanding of the trends in retail payments, as well as of what potential measures to take to further foster the use of the most socially cost efficient payment instruments. Therefore, seven separate surveys are designed and conducted to collect transaction records among 5,400 consumers. Each study differs from the others in terms of survey length, data collection mode or sampling frame. The seven datasets are validated against transaction data supplied by retailers and the national debit card scheme and used for econometric analyses. Chapter 2 adds to the existing literature in that it provides an explanation for the variation between existing cash estimates. Moreover, its sheds light on the different types of errors arising in payment surveys and on what method provides the most reliable estimate of the number of cash payments made by consumers. This method is subsequently employed for the collection of the payments data used in Chapter 3.

1.6.2 Chapter 3: Role of foreign background in consumer payment choice

Turning to the thesis' main question, Chapter 3 studies whether having a foreign background is a relevant factor in choosing between payment instruments at the POS after migration. This question is econometrically analysed by means of Probit estimation techniques using a unique diary survey in which 2,258 residents of the Netherlands documented their daily purchases. The innovative aspect of this diary survey is that detailed information was collected from both individuals with a Dutch and a foreign background, using the survey method as suggested in Chapter 2. By combining this data with national payment statistics collected by the World Bank (2008) and controlling for a variety of consumer, transaction and location characteristics, this chapter sheds light on the role of home-country payment habits and on possible changes after migration. In focusing on foreign backgrounds, this chapter relates to earlier work that reports differences in payment behaviour based on race and ethnicity (e.g. Borzekowski and Kiser (2008), Borzekowski et al. (2008), Ching and Hayashi (2010), Schuh and Stavins (2010), Mann (2011)). However, these papers do not have detailed information on respondents' country of origin. A second key difference is that these papers are not able to distinguish between different generations. By contrast, the extensive dataset used in Chapter 3 allows for an examination of whether payment preferences differ between generations. Herewith, this chapter provides new insights into whether and how the use of electronic payment instruments can be further stimulated.

1.6.3 Chapter 4: The safety of paying: consumer perceptions and payment choices

Chapter 4 investigates the role of perceived safety in consumers' payment choice. More precisely, its objective is to assess the determinants of consumers' safety perception and the impact of perceived safety on the use of cash and debit cards. To this end, 2008 consumer survey data is used for

various econometric analyses to assess how consumers' views on the safety of POS payment instruments are influenced by perceptions of probabilities of incidents occurring when carrying or using a given payment instrument and by perceptions of the severity of these incidents. Until now, this approach of separating the probability of losses and the severity given losses has not been considered in payments research before. Furthermore, Probit estimation techniques are used to assess whether consumers' views about probabilities and consequences vary with personal characteristics and personal experiences, and how perceived safety influences the use of cash and debit cards. By studying the entire chain from safety perception to payment behaviour, Chapter 4 provides new insights into whether safety is a factor that may hinder the use of electronic payment instruments. Also, it allows for gaining a better understanding of how to preserve consumers' confidence in the safety of paying and of how to further stimulate electronic ways of paying.

1.6.4 Chapter 5: Do newspaper articles on card fraud affect card usage?

Chapter 5 examines the impact of newspaper articles about debit card skimming fraud on aggregate debit card usage in the Netherlands, using a rich set of daily debit card transaction data and daily newspaper announcements from January 1st 2005 to December 31st 2008. Time-series analyses are employed to assess the direction and strength of the newspaper effects, as well as the degree to which consumers' reactions vary with the specific characteristics of the publications, such as the type of skimming fraud addressed and their position in the newspaper. Moreover, by further breaking down the dataset by period, Chapter 5 looks into the extent to which consumers' reactions to skimming fraud news have changed over time. In using *actual* debit card transaction records and *actual* newspaper announcements, this chapter adds to earlier work touching upon the role of payments safety, which is mainly based on *perceptions* and *stated* behaviour.

Moreover, to the best of our knowledge, the impact of media reports on the use of payment instruments has not been studied before. Therefore, Chapter 5 presents new insights into the extent to which payment choices are affected by safety incidents and in particular by the media attention they receive. These insights are relevant for gaining a deeper understanding of whether and how safety incidents may pose a barrier to a further growth in the use of electronic payment instruments, and, hence, of what measures to take to prevent consumers from reverting to alternative ways of paying that are more costly to society.

1.7 Outline

The outline of this thesis is as follows. Chapter 2, 3, 4 and 5 present the results of the empirical analyses mentioned above. Chapter 6 then summarises and draws some final conclusions in the light of the two above-described research topics and the thesis' main research question. Furthermore, several policy implications and directions for future research are discussed.

Chapter 2

Measuring payment choices: The impact of survey design on cash estimates[1]

What is the best way to measure the number of cash payments made by consumers? To answer this question, we design, conduct and analyse seven surveys, each one using a different method to ask consumers about their daily purchases. We demonstrate that the survey method and the duration of the survey period significantly affect consumers' ability to recall and record their payments. We conclude that the quality of cash estimates benefits from using a self-reported payment diary. In particular, we show that consumers tend to forget their low value cash payments when participating in a retrospective recall questionnaire. However, we also demonstrate that about 40% of the transactions registered in a one-day diary are missed out when using a one-week diary. This suggests that payment diaries are vulnerable to 'diary fatigue' and 'diary despair'. Therefore, one-day diaries are to be preferred for the collection of reliable cash data.

[1]This chapter is based on Jonker, N. and Kosse, A. (2013), Estimating cash usage: The impact of survey design on research outcomes, *De Economist* 161: 19-44.

'Not everything that can be counted counts,
and not everything that counts can be counted'
Albert Einstein (1879 - 1955)

2.1 Introduction

Accurate data on the payment choices made by consumers are key to assessing the drivers underneath. The number and value of non-cash payments are usually recorded by banks and/or payment processors. By contrast, due to their anonymous nature, actual data on the total number and value of cash payments are lacking. This not only hinders a profound analysis of consumers' choices between instruments, it is also an important barrier to the monitoring of retail payment habits and the associated payment costs over time. The value of banknotes and coins in circulation and the value of cash withdrawals are often used as an indication of total cash usage (e.g. Humphrey et al. (2001), Leinonen (2008) and Amromin and Chakravorti (2009)). Yet, these statistics are only indicative of the total cash value used, and they ignore the fact that part of the money in circulation is used as a store of value and not for making payments. Also, these statistics do not provide information about cash use in terms of the number and nature of the cash payments made, such as for what purposes, at what places or for what amounts.

One way to assess cash usage among consumers, therefore, has been to use transaction data supplied by retailers (Klee (2008)) or to post researchers near the counter to keep record of all the transactions (Kippers (2004)). These so-called 'retailer approaches' allow for a relatively easy way of collecting a large number of payments. However, to gain a profound insight into the use of cash across the entire economy, such an approach would require a representative sample of all possible places where consumers may potentially make a cash payment, which, among others, not only include shops and supermarkets, but also vending and ticket machines, bars and

market places. Given the heterogeneous nature of all these points-of-sale, this would be a relatively difficult and costly exercise. Consequently, as it is less hard to draw a representative consumer sample, the most common approach to measure the number and characteristics of cash transactions has been to use surveys among samples of consumers. This, however, asks for a sound survey methodology, as sample-based surveys are typically sensitive to survey errors that may cause results to deviate from reality.

There are various studies on the size and nature of survey errors in health, expenditure and income research (e.g. Ahmed et al. (2006), Gibson and Kim (2007), Estelami and Lehmann (2001), Lynn et al. (2012)). Yet, literature on survey errors arising in payments research is scarce. A comparison of different estimates, however, does show evidence of survey errors being present. In the Netherlands, for instance, annual cash estimates for the year 2003 range from 2.8 billion (Currence (2005-2007)) to 7.6 billion transactions (TNS Nipo (2003)). These studies greatly differ in terms of survey method used. Which method is most accurate, however, has remained unclear. Therefore, before turning to the main research topics of this thesis, the aim of this chapter is to assess what is the best way to measure consumers' payment behaviour, and in particular the number and characteristics of their cash payments made. Having insight into the use of cash at such a detailed level is important for understanding consumers' reasons for using cash. This allows for a better understanding of the trends in retail payments, as well as of what potential measures to take to further foster the use of the most socially cost efficient payment instruments. Therefore, we design and conduct seven separate surveys to ask consumers about their daily payments. Each survey differs from the others in terms of survey length, data collection mode (i.e. retrospective recall questionnaire vs. payment diary; telephone vs. online) and sampling frame (i.e. telephone vs. online panel). The seven datasets are validated against actual payments data and used for econometric analyses. By doing

so, this chapter adds to the literature in that it provides an explanation for the variation between existing cash estimates. Moreover, it provides insight into the different types of survey errors arising in payment surveys, and into what survey method reduces overall survey error most.

This chapter proceeds as follows. Section 2.2 presents an overview of the literature to provide a picture of the various types of errors that may arise in payment surveys, and formulates the main research question. Section 2.3 describes the methodology and data, whereas Section 2.4 presents the results. Section 2.5 summarises and concludes.

2.2 Background and research question

2.2.1 Related literature

Questionnaires, self-reported diaries and experiments among samples of respondents are widely accepted research techniques for understanding and assessing consumer behaviour. Yet, these sample-based surveys are typically sensitive to various types of errors that may cause the results to deviate from reality. Most common are sampling errors, coverage errors, non-response errors and measurement errors (e.g. Bethlehem (2010)). Sampling errors arise from errors in the process by which a sample is selected from the population, whereas coverage errors arise when certain population groups are not covered by the sampling process. Non-response errors relate to the failure of the sampled persons to respond, and measurement errors occur when surveys do not measure what they purport to measure. Sampling errors can be quantified from the data on the basis of confidence intervals. However, survey data do not provide evidence of the other types of errors, as a result of which overall survey error is difficult to estimate. Some studies have tried to estimate it by comparing different studies (e.g. Ahmed et al. (2006) and Gibson and Kim (2007)) or by validating survey results against data gathered from administrative sources (e.g. Estelami and Lehmann (2001) and Lynn et al. (2012)). The major problem en-

countered, however, is that validation sources themselves often suffer from inaccuracies too.

There are indications that surveys used to collect data on the use of payment instruments suffer from survey errors too. In the Netherlands, for instance, several studies have been conducted to estimate the number and relative share of cash payments made by consumers. The results vary widely, however, as well as the survey methods used. For example, Currence (2005-2007) required consumers to keep a payment diary for seven days and generated annual cash payment estimates of 2.8 billion transactions in 2003 and 3.2 billion transactions in 2006. By contrast, according to TNS Nipo (2003) cash usage in 2003 was considerably higher: 7.6 billion transactions. Here, the respondents were asked to complete a detailed online recall questionnaire. These differing cash estimates indicate the presence of survey error. Which estimate, and hence, which survey method is most accurate, however, has remained unclear.

Payment surveys may especially be sensitive to coverage, sampling and measurement errors. Online panels have become common instruments for assessing consumers' choices between payment instruments, since they allow for a relatively fast and low-cost data collection. Online panels, however, may lead to coverage errors when people without internet access are beforehand excluded from participation (e.g. Bethlehem (2010)). In particular, the survey results may suffer from coverage errors when certain population groups with specific payment patterns, such as the elderly and low-income groups, are not represented. Second, online panels may introduce sampling errors due to selection biases. That is, participants in these 'modern' types of panels may have a relatively positive attitude towards 'electronics' in general, and therefore potentially have a stronger than average preference for electronic payment instruments. Finally, payment surveys may be subject to measurement errors. In particular, surveys asking consumers about their daily payments may be vulnerable to measurement errors caused by incomplete recall, social desirability and telescoping.

Incomplete recall

Consumers participating in payment surveys may have difficulty in recalling all of their payments, leading to so-called incomplete recall error. The ability to accurately recall their payments may first be influenced by the number of days over which consumers are asked to report their behaviour. Evidence from other research fields suggests that the further respondents have to go back in history, the harder it gets to correctly recall and report the events in question (e.g. Sudman and Bradburn (1973) and Linton (1982)). Second, non-salient events, i.e. events that are of less importance in a person's life, are found to be difficult to remember. Consumer expenditure surveys, for example, are found to significantly suffer from an underestimation of small expenditures and frequent purchases (e.g. Gibson and Kim (2007), Sudman and Bradburn (1973), Alessie, Gradus and Melenberg (1990) and van Praag and Vermeulen (1993)). As low value purchases are often paid in cash (e.g. Bounie and François (2006), Klee (2008), von Kalckreuth et al. (2009)), payment surveys may therefore be especially vulnerable to underreporting of cash payments. Third, consumers' ability to correctly recall their payments may be affected by the data collection method used. Several studies suggest that telephone and face-to-face recall questionnaires, due to the interviewers' ability to help the respondents, have potential to reduce recall errors (see Bowling (2005) for a synopsis). By contrast, others show that self-reported diaries in which consumers keep record of their behaviour generate more accurate information (e.g. Sudman and Lannom (1980), Scott and Okrasa (1998), Gibson (2002), Battistin, Miniaci and Weber (2003), Ahmed et al. (2006), Wutich (2009)). Regarding the length of such diary surveys, there are no clear guidelines. Asking consumers to keep a diary for multiple days is attractive for collecting many observations in a relatively easy way. In payments research, week diaries in which consumers are asked to register all their payments for one week are commonly used (e.g. Bounie and François (2006), Currence (2005-2007), von Kalckreuth et al. (2009)). They may, however, place a considerable

burden on the respondents, which could seriously affect their compliance and hence the validity of the results. Tincello, Williams, Joshi, Assassa and Abrams (2007) and Ahmed et al. (2006), for instance, show that multiple-day diaries are sensitive to underreporting due to 'diary fatigue', i.e. loss of commitment and accuracy after a couple of days, and 'diary despair', i.e. immediate loss of commitment and accuracy due to the prospect of completing a diary for multiple days. Again, in particular, small non-salient events are found to be underreported.

Social desirability

Sometimes consumers may recall their payments in great detail but still not report them when being surveyed. This could be related to social desirability. People may be reluctant to reveal their true behaviour when they think this behaviour is disapproved by others. Bound, Brown and Mathiowetz (2001), for instance, find that survey measures of benefit receipts are subject to underreporting due to conscious suppression. Conversely, respondents may invent 'good' behaviour, resulting in overreporting. Overall, due to the personal contact with the interviewer, telephone and face-to-face questionnaires are found to be more vulnerable to social desirability errors than online questionnaires (e.g. Kreuter, Presser and Tourangeau (2008) and Holbrook and Krosnick (2010)). Social desirability may play an important role in payment surveys, as consumers may have various reasons for being reluctant to report certain transactions. Given the anonymous nature of cash, this may particularly lead to an underestimation of the number and value of cash payments. In addition, consumers may generally be encouraged by banks and retailers to pay by debit card. As a result, during their survey period, respondents may have a tendency to not be honest about their true debit card use, or to use their card more often than they normally do. In that case, the results would suffer from an overestimation of debit card use.

Telescoping

Another phenomenon that may potentially lead to measurement errors in payment surveys is telescoping. Telescoping refers to respondents being mistaken about the exact moment in time an event occurred. This may result in either under- or overreporting. Brown, Rips and Shevell (1985) and Sudman and Bradburn (1973), for instance, find that consumers perceive events that are clearly remembered to have occurred more recently than they actually did. As a consequence, salient events are found to be overreported. Similar errors may occur in payment surveys. Due to their salient nature, high value purchases may be perceived to have occurred more recently and hence be overreported. In particular, multiple-day diary surveys may therefore be vulnerable to an overestimation of high value payments, as potential diary fatigue and diary despair may cause respondents to postpone updating their diary until the end of the survey period, as a result of which they have to go back in history for multiple days.

2.2.2 Research question

The literature as summarised in Section 2.2.1 suggests that consumer surveys measuring the use of payment instruments may be vulnerable to various types of errors, such as coverage, selection and measurement errors. Given this background, the aim of this chapter is to assess to what extent payment surveys are vulnerable to online selection biases, recall errors, social desirability errors and telescoping errors. Moreover, we examine how these errors are correlated with the particular survey design in terms of the way the respondents are selected, the type of recall questionnaire and/or payment diary used, and the length of the survey period. By doing so, this chapter aims to provide an answer to its main research question: *"What is the best way to measure the number of cash payments made by consumers?"*.

2.3 Methodology and data

2.3.1 Survey design

To answer the research question formulated in Section 2.2.2, we designed and conducted seven separate surveys, each one using a different survey or sampling method. As will be discussed in detail in Section 2.3.4, we will employ actual transaction records to examine the quality and validity of each survey method. Subsequently, once having a clear picture of their performance, we will mutually compare the surveys' outcomes to assess the effect of their individual features. The main characteristics of the seven surveys are presented in Table 2.1. In Survey 1, a representative sample of over 1,000 consumers was drawn from an online consumer panel. The consumers were requested to document their point-of-sale (POS) payments during one particular day in a paper payment diary. For each payment, they were asked to register its amount, the payment instrument used and the spending place. In order to minimise non-response among 'non-payers', we stressed that even if they did not make any payment at all during the

Table 2.1: Key characteristics of seven payment surveys

	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
Sampling frame:							
Online panel	X	X	X	X			
Telephone panel					X	X	X
Paper-based payment diary:							
For one-day	X	X		X	X		
For one-week						X	X
Retrospective recall questionnaire:							
By telephone		X			X		
Online	X		X				
Interim reminder						X	

Note: This table presents the main characteristics of the seven surveys designed and conducted to assess what survey method provides the most reliable estimates of the number of cash payments made by consumers.

respective day, this was still relevant for us to know, so as to encourage them to participate also in that case. The respondents could use their completed diary to jog their memories when answering an online recall questionnaire the day after, asking about all the payments made during the previous day. In Survey 2, a similar group of respondents was drawn from the same online consumer panel. They also received a paper payment diary for one single day. However, the subsequent recall questionnaire was conducted by telephone instead of online. Survey 3 differed from Survey 1 in that the respondents were not asked to keep a payment diary. Instead, they only received an online recall questionnaire asking them about the payments made during the previous day. By contrast, in Survey 4, the respondents were only asked to keep a paper payment diary and to return it by regular mail. So they were not approached for an additional recall questionnaire. Survey 5 is a variation on the previous surveys in that the respondents were not drawn from an online panel, but from a consumer panel that is usually used for telephone surveys. So, the participants did not need to have access to the internet. Other than that, the same methods were used as in Survey 2. The respondents to Survey 6 and Survey 7 too, were taken from a panel of consumers who are not required to have internet access. Moreover, Survey 6 and Survey 7 differ from the others in that respondents were asked to keep a payment diary for one entire week. Moreover, they solely completed and returned the diary and did not participate in an additional recall questionnaire. In addition, in Survey 6, the participants received an interim reminder after 3 or 4 days. In sum, the seven surveys are designed in such a way to answer the following questions:

Question 1 *Does combining a retrospective recall questionnaire with a payment diary (Survey 1) lead to different payment estimates compared to merely using a retrospective recall questionnaire (Survey 3)?*

The aim of this question is to establish whether asking consumers to also report their daily payments in a payment diary as suggested by e.g. Sudman

and Lannom (1980) and Battistin et al. (2003), generates more accurate information compared to solely using retrospective recall questionnaires asking them to recall their payments by heart. In that case, we expect to find either a significantly higher or a lower number of recorded payments when using both a recall questionnaire and a payment diary than when only using a recall questionnaire. A higher number of especially low value cash payments recorded in Survey 1 would point to the single recall questionnaire used in Survey 3 being subject to recall errors. By contrast, a lower number of in particular high value payments in Survey 1 would hint at the single questionnaire used in Survey 3 suffering from telescoping errors.

Question 2 *Does combining a payment diary with a retrospective recall questionnaire (Survey 1) lead to different payment estimates compared to merely using a payment diary (Survey 4)?*

With this question we intend to assess whether an additional recall questionnaire reduces the potential presence of recall errors in payment diaries. Due to the personal contact or the ability to add highly specific questions, additional telephone or online recall questionnaires may help respondents to recall payments which they initially forgot to register in their payment diary (e.g. Bowling (2005)). In that case we expect to find a higher number of especially low value cash payments in Survey 1 using both a payment diary and a recall questionnaire, than in Survey 4 using a payment diary only.

Question 3 *Do retrospective telephone questionnaires (Survey 2) lead to different payment estimates compared to retrospective online questionnaires (Survey 1)?*

This question further addresses the effect of the data collection method. According to the literature, when using a telephone questionnaire, the interviewer may help consumers to recall payments which are easily forgotten, thereby reducing potential recall errors (e.g. Bowling (2005)). If this is the

case, we would expect to find a higher number of especially low value cash payments in the telephone survey (Survey 2) as opposed to the online survey (Survey 1). However, as discussed in Kreuter et al. (2008) and Holbrook and Krosnick (2010), telephone interviews may be sensitive to social desirability error. A higher number of debit card and a lower number of cash payments in Survey 2 would hint in this direction.

Question 4 *Do respondents drawn from online consumer panels (Survey 2) report different payment choices compared to respondents taken from a telephone panel (Survey 5)?*

The objective of this question is to examine to what extent online consumer panels lead to biases in favour of electronic payments, due to undercoverage of certain groups with particular payment habits, or due to overselection of 'online-minded' people as discussed in Bethlehem (2010). If people participating in online panels would have a stronger than average preference for electronic means of payment, we would expect to find a lower (higher) number or share of cash (card) payments when drawing a sample from an online panel (Survey 2) instead of from a telephone panel (Survey 5).

Question 5 *Does the length of the diary registration period affect the outcomes of a payment diary (Survey 5 versus Survey 7)?*

As suggested by the literature (e.g. Tincello et al. (2007), Ahmed et al. (2006)), multiple-day payment diaries may be sensitive to diary fatigue and diary despair and therefore be subject to recall and telescoping errors. A lower number of low value cash payments recorded in the one-week diary (Survey 7) compared to the one-day diary (Survey 5) would be an indication of the former error. By contrast, a higher number of higher value payments in Survey 7 would hint at telescoping errors.

Question 6 *Do interim reminders improve the survey outcomes of multiple-day payment diaries (Survey 6 versus Survey 7)?*

The aim of this question is to assess whether interim reminders are able to reduce potential survey length-related measurement errors in multiple-day diaries. If so, we expect to find a higher number of low value cash payments and a lower number of higher value payments in Survey 6 using an interim reminder than in Survey 7.

2.3.2 Data collection

All seven surveys were conducted from Thursday August 30 until Wednesday September 29 2007. The one-day surveys, Survey 1 - Survey 5, were carried out by the research agency TNS Nipo. The one-week surveys, Survey 6 and Survey 7, were conducted by research agency GfK. In order to minimise the potential impact of employing two different agencies, meetings were organised so as to align the research methods to a maximum.[2] As a result, all surveys equalled in terms of types of payments covered (i.e. retail trade, catering industry, gas stations, vending and ticket machines, cultural and recreational activities, as well as person-to-person (P2P) payments among consumers) and the research population (i.e. Dutch consumers aged 12 to 75). Moreover, all respondents received a clear explanation about the purpose of the survey, as well as a small financial incentive in the form of points that can be collected and eventually spent as regular money.

For all surveys, the respondents were randomly selected from existing consumer panels. The respondents to Survey 1 - Survey 5 were drawn from the TNS NIPObase. This database consists of more than 200,000 consumers, 65% of which are able to participate online. The respondents

[2]Ideally, one would like to use one research agency in order to prevent any potential biases. However, the decision of using two agencies was driven by their specific expertise and knowledge. In particular, TNS Nipo had considerable experience of conducting payment questionnaires, whereas GfK regularly conducted one-week payment diaries. Hence, in order to take full advantage of their expertise and tools, we involved both agencies.

to Survey 6 and Survey 7 were taken from the GfK panel containing over 15,000 households, both with and without internet access. The main advantages of these so-called access panels are that members often display a high willingness and discipline to participate and that they allow for a relatively fast and low-cost data collection. Moreover, since the respondents' socio-demographics are known in advance, the sample can be balanced beforehand, and if necessary corrected afterwards.[3] The respondents were selected in such a way to ensure representativeness in terms of gender, age, education and region. Moreover, the respondents were equally spread over the entire research period. The aim was to have at least 400 respondents for each survey, so to be able to draw valid conclusions regarding the true number of payments made in the Netherlands in September 2007, based on a 95% confidence level and a 5% confidence interval. To this end, around 560 members were contacted in Survey 6 and 7. For the one-day surveys, a higher number of respondents was selected to be sure that the target would be met.

2.3.3 Key statistics

Table 2.2 shows the key characteristics of the respondents to the seven surveys. The target number of respondents was met in all surveys and varies between 494 in Survey 6 to 1,077 in Survey 5. Of the respondents participating for one single day, more than 75% recorded at least one payment. In Survey 6 and 7, nearly 90% of respondents recorded a payment during their registration week. Due to the differences in survey length, the total number of payments registered fluctuates between 1,279 in Survey 3 and

[3]One caveat of access panels is that they may be sensitive to coverage errors and selection bias (see, for example, Bethlehem (2010)). Ideally, one would like to use real probability sampling in which every person in the population has the same probability of being approached for participation, such as national population registers. However, given the scarcity of appropriate databases and the high costs of using them, we used these two access panels which are commonly used for qualitative and quantitative research in the Netherlands. In order to minimise potential undercoverage and self-selection of particular population groups, both panels are continuously monitored and adjusted to guarantee their representativeness.

Table 2.2: Characteristics of survey participants

	Population	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
Target no. respondents		400	400	400	400	400	400	400
Final no. respondents		845	1,017	638	1,077	831	499	494
Respondents who recorded at least one payment		80%	75%	76%	81%	79%	87%	87%
Total no. payments recorded		1,926	2,129	1,279	2,427	1,827	4,368	4,321
Female	50%	53%	53%	52%	51%	55%	54%	56%
Age:								
12 - 17	6%	11%	15%	10%	12%	11%	7%	5%
18 - 29	21%	18%	15%	14%	14%	17%	15%	17%
30 - 39	21%	17%	20%	17%	18%	17%	27%	26%
40 - 49	23%	17%	13%	15%	17%	17%	21%	18%
Over 50	29%	37%	37%	44%	40%	40%	30%	33%
Education:								
None	1%	1%	0%	1%	1%	1%	0%	0%
Primary	8%	6%	7%	6%	5%	4%	5%	3%
Secondary	65%	68%	69%	71%	72%	60%	59%	57%
BA	16%	18%	16%	16%	16%	27%	26%	28%
MA	9%	8%	8%	6%	6%	9%	10%	12%
Region of residence in the Netherlands:								
West	46%	39%	42%	45%	42%	42%	29%	30%
North	11%	11%	12%	12%	11%	10%	15%	17%
East	21%	23%	22%	20%	21%	21%	26%	24%
South	22%	26%	24%	23%	26%	27%	30%	29%
Internet access	83%	99%	98%	98%	98%	94%	99%	99%

Note: This table summarises the various characteristics of the respondents to the seven surveys. Column 1 gives data for the Dutch population in 2007 aged over 15 provided by Statistics Netherlands and Eurostat Statistics (http://epp.eurostat.ec.europa.eu). The data are un-weighted.

4,369 in Survey 7.

The seven samples differ in several ways from the Dutch population. In general, the respondents are more often female, middle-aged and more likely to have internet access. Moreover, Table 2.2 shows evidence of considerable differences between the samples themselves. On average, the respondents to Survey 6 and 7 are higher educated, more middle-aged and less likely to live in the western part of the Netherlands compared to those in Survey 1 - Survey 5. Given these differences, we constructed sampling weights based on gender, age, education, region and internet access. Second, given the strong variation of payments over the week and month, we weighted the results based on the number of respondents per day to avoid that the days with relatively many respondents would have a too strong impact on the final payment estimates. Finally, we corrected the survey results for the correlation found between the non-responses and the number of payments made by the participants. That is, after the research period, for each survey we randomly contacted a sample of non-responders to check whether their non-response had been driven by the fact that they had not made any payment during their survey period. We found that the share of 'zero payments' was indeed higher among the non-responses than among the final respondents. To correct for this underrepresentation of 'zero payers', we used this information to weight the final results for any bias of this kind.

Table 2.3 presents an overview of the weighted average number and value of payments recorded per person per day. The differences across the surveys are substantial. Overall, the respondents who only completed a retrospective recall questionnaire (Survey 3) and those participating in the one-week diary surveys (Survey 6 and 7) reported a lower number of payments per day than the respondents to the one-day diary surveys (Survey 1, 2, 4 and 5). In particular, the daily number of cash transactions is substantially lower. This may be an indication of the recall questionnaire and the week surveys being subject to recall error, which in the latter case may be caused by diary fatigue or diary despair. Also, Table 2.3 shows

Table 2.3: Average daily number and value of payments per respondent

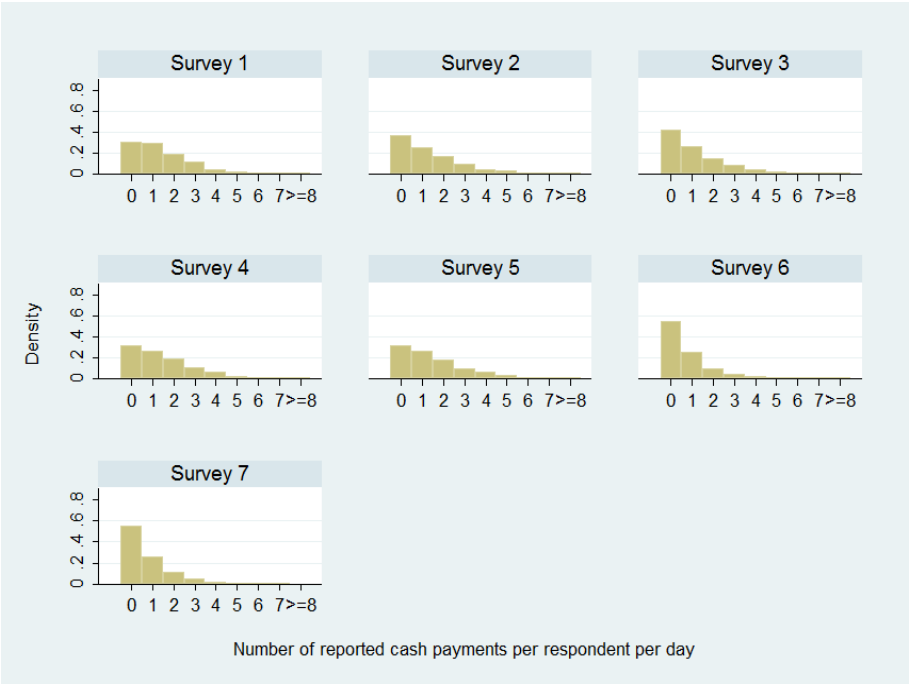
	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
Total no. payments	1.83	1.76	1.64	1.83	1.81	1.10	1.10
	2.40	*2.49*	*2.42*	*2.45*	*2.66*	*2.16*	*2.11*
No. cash payments	1.25	1.14	0.93	1.25	1.34	0.75	0.73
	1.65	*1.60*	*1.34*	*1.78*	*2.09*	*1.37*	*1.26*
No. debit card payments	0.47	0.51	0.60	0.45	0.41	0.31	0.30
	0.51	*0.68*	*0.74*	*0.52*	*0.48*	*0.50*	*0.50*
Average transaction value (EUR):							
Total	17.79	19.09	26.93	18.70	19.58	22.60	23.95
Cash	10.92	10.68	18.88	11.85	13.42	13.95	17.61
Debit card	37.19	39.66	38.44	36.72	40.05	39.33	37.02

Note: This table presents the average number and variance (in italics) of payments recorded per person per day in the seven surveys. The first row refers to the total number of daily payments, whereas the following rows focus on cash and debit card payments only. The last rows present the average transaction values recorded for all payments, as well as for cash and debit card transactions only. Numbers and values are based on all respondents, including those who reported zero payments. For Survey 6 and Survey 7, the average daily number of recorded payments across the seven days is presented. Data are weighted on the dimensions as explained in the main text.

considerable variations in terms of the average cash transaction values reported. Overall, the average cash value is highest among the respondents to the one-week diaries and among those who did not keep a diary at all. This may indicate that the one-week surveys and the retrospective recall questionnaire particularly suffer from incomplete recall of low value cash payments. We will further examine this in Section 2.4.

Taking a closer look at the daily number of transactions reported in each survey, Figure 2.1 and Figure 2.2 depict the density functions for both the number of cash and debit card payments. They provide a first insight

Figure 2.1: Density of reported cash payments per respondent per day



Note: This figure presents the densities of the number of reported cash payments per respondent per day for each separate survey. For Survey 6 and Survey 7, the average daily number of cash payments across the seven days is shown. Data are weighted on the dimensions as explained in the main text.

into the nature of the variations found in Table 2.3, and in particular into the differences between the five one-day surveys (Survey 1 - Survey 5) on the one hand and the two one-week surveys (Survey 6 and 7) on the other. Overall, the number of people that, on a daily level, did not report any payment at all is considerably higher in Survey 6 and Survey 7 than in the one-day surveys. The differences are most pronounced for cash (Figure 2.1). Second, Figure 2.1 and Figure 2.2 show that in Survey 1 - Survey 5 the densities gradually decline for higher numbers of payments. By contrast, the distribution functions of Survey 6 and 7 decline more steeply, which

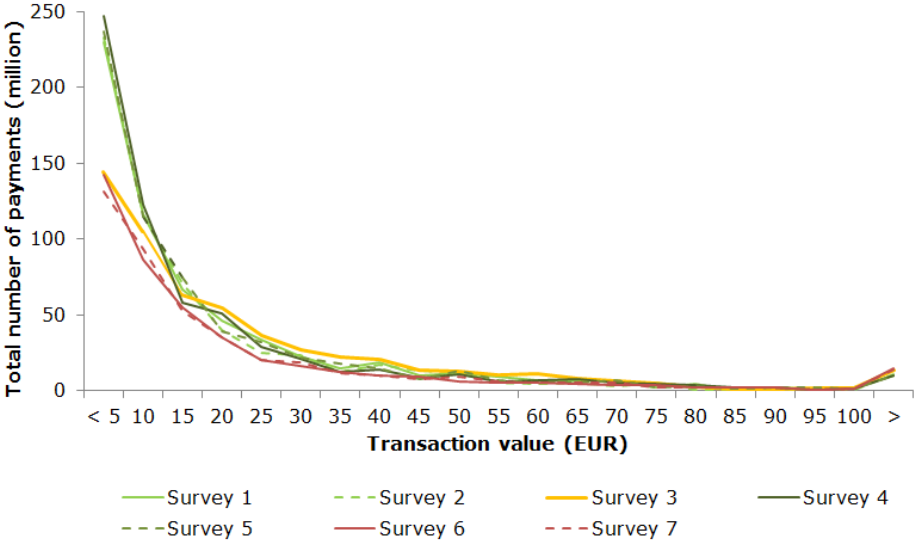
Figure 2.2: Density of reported card payments per respondent per day

Note: This figure presents the densities of the number of reported debit card payments per respondent per day for each separate survey. For Survey 6 and Survey 7, the average daily number of debit card payments across the seven days is shown. Data are weighted on the dimensions as explained in the main text.

means that relatively fewer people recorded two, three or more payments. This, again, hints at a potential effect of survey length. In Section 2.4, we will further explore whether the large shares of zero payments and the lower fractions of higher numbers of payments in the one-week surveys can be explained by errors caused by diary fatigue or diary despair.

Turning to the number of payments recorded by transaction value, Figure 2.3 presents an overview. In all surveys, the frequency of payments sharply declines with the size of the payment. Overall, about one third of all recorded transactions have a value of EUR 5 or lower. Figure 2.3, however, points at some remarkable survey differences. First, the number of low value transactions is obviously higher in Survey 1, 2, 4 and 5 compared

Figure 2.3: Total number of payments by transaction value



Note: This figure presents the total number of payments by transaction value as estimated by each survey for September 2007. Numbers are calculated by multiplying the total number of reported payments per respondent per day by 30 days and the size of the Dutch population of 12 years and older in 2007. Data are weighted on the dimensions as explained in the main text.

to Survey 3, 6 and 7. The discrepancies converge as the value increases. This may, again, be an indication of Survey 3, 6 and 7 suffering from recall error of in particular small purchases. Second, Figure 2.3 suggests that the respondents in Survey 3 reported relatively many payments of EUR 20 and higher. This may point to potential telescoping error. That is, in Survey 3 the respondents did not use a payment diary and thus had to recall their payments by heart. As discussed in Section 2.2.1, this may have led to forward telescoping, with higher value payments being perceived as having occurred more recently and, hence, being overreported. We will further analyse this in Section 2.4.

2.3.4 Empirical model and estimation method

Overall, the first results show considerable differences across the various surveys in terms of the number and value of, in particular, cash payments reported. Before turning to a formal analysis of the role of the survey methods used, it is essential to have a clear understanding of the quality and validity of each survey. Therefore, we first examine to what extent the surveys' results are a good representation of the actual payment choices made. Although actual data on the total number of cash payments made across the country are lacking, we are fortunate to use two reliable validation sources on the use of payment instruments in the retail trade. First, we compare the surveys' card payment estimates with actual September 2007 debit card transaction data provided by Currence, the owner of the Dutch debit card scheme. Second, for validating the surveys' cash results, we use information collected by EIM (2007) on the number of cash payments made in the Dutch retail trade in 2006. This source is unique in that it contains reliable data on cash usage supplied by 31 large and 350 small and medium-sized retailers. Since a large part of the transactions was retrieved from electronic cash registers that record the true number and type

of transactions received, this data can be considered to be highly robust.[4] Given the scope of the EIM (2007) data, our validation exercise will focus on the payments made in the retail trade only. We calculate the actual number of payments made per person per day by dividing the data from EIM (2007) and Currence by 365 and by the size of the Dutch population aged between 12 and 75. Then, for each survey we estimate the means, standard deviations and the corresponding 95% confidence intervals using the weighted survey data. Finally, we test whether the validation data fall within the surveys' confidence intervals.[5] The results are presented and discussed in Section 2.4.1.

In the next step, we estimate an econometric model to formally assess the impact of the survey methods used on the number of payments recorded. Table 2.3 and Figures 2.1 and 2.2 showed that the payments data follow a discrete distribution taking on non-negative integer values only. Since the majority of respondents reported either zero, one or two payments, count data regression models are to be preferred for explaining the daily number of payments recorded by the respondents (e.g. Cameron and Trivedi (1998)). The standard Poisson model may be too restrictive, as it assumes equality of the mean and the variance, whereas in our data (see Table 2.3) the average variances in the number of payments exceed the average means, which shows that the data are overdispersed. Given this overdispersion, a sound practice is to use a negative binomial model. However, as many respondents reported zero payments, the data may also suffer from the 'zero inflation' problem, i.e. the problem of having too many zero observations. Furthermore, the reason for reporting zero payments may be twofold. That

[4]The large retailers retrieved actual payments data from their electronic databases. Some small and medium-sized retailers also provided actual information from their databases, others made a best guess estimate.

[5]Since EIM (2007) does not provide information on the standard deviations, we take the retailer data as given and, hence, are not able to take the standard deviations into account in the validation tests by, for instance, employing two-sample t-tests. We therefore use a more conservative test of equality. We do not expect this to substantially affect the results, as the differences between retailer and consumer data are often large. Moreover, the test results show p-values well below the critical value of 0.05.

is, in response to the question "How many cash payments did you make yesterday?", zero would be recorded by those who did not pay their purchases in cash, as well as by those who did not make any purchase at all. In the latter case, the outcome will always be zero. By contrast, if a consumer did make a purchase, the number of cash payments would either be zero or non-zero, depending on the payment instrument used. Therefore, our payments data including both zero and positive counts may be a mixture of two data generating processes: (i) a process which always generates zeros, i.e. 'excessive' zeros, due to not having made any purchase at all, and (ii) a count process for those who did make a purchase, generating both zero and positive counts depending on the payment instrument used. Given this background, we use a Zero Inflated Negative Binomial (ZINB) model to account for the overdispersion of the data and to simultaneously model the two distinct processes. Here we assume process (i) to follow the binomial logistic distribution, and process (ii) to follow the negative binomial distribution.[6] Since the analysis is at the transaction- rather than at the consumer-level, we cluster the standard errors by respondent to allow for potential correlation across different payments made by the same person.

The ZINB model contains two sets of explanatory variables: (i) variables determining whether an observation falls in the 'always zero' process ($Zero$), and (ii) variables stored in the 'total counts' process ($Counts$) explaining the daily number of payments recorded by payment instrument, if having made a purchase. Since the same factors may govern both processes, we use the same set of consumer demographics for both processes. We use dummy variables for the respondent's gender (Sex), region of residence in the Netherlands (Reg), age category (Age) and education category (Edu).

[6]The results of the validation exercise presented in Section 2.4.1 reveal that the one-day surveys overestimate the number of debit card payments. As this may be due to an underestimation of zero card payments (e.g. due to the respondents not being honest about or changing their card usage on account of the social desirability factor), a zero deflated model may be more suitable for estimating the number of debit card payments. However, such a model does not account for the heterogeneous character of people's payment preferences. Yet, it would be interesting for future research to further explore the possibilities of zero deflated models and finite mixed models.

We also include a dummy variable indicating whether the respondent has access to the internet at home (Int) to account for potential selection biases related to the electronic-mindedness of the respondent.[7] In addition, we use dummies to account for the day of the week (Day). Finally, in order to assess the impact of the different survey methods used, we add survey dummies to the model indicating in which of the seven surveys the respondents had participated ($Survey$). Consequently, the two processes can be summarised as follows:

$$Zero = Zero(Survey, Day, Sex, Reg, Age, Edu, Int) \tag{2.1}$$

$$Counts = Counts(Survey, Day, Sex, Reg, Age, Edu, Int) \tag{2.2}$$

If the estimation results show evidence of a significant survey dummy ($Survey$) effect in the 'always zero' process, this would suggest that somehow by its design, this survey causes respondents to report either more or fewer excessive zeros due to not having made any purchase at all. Similarly, if a survey dummy turns out to be significant in the 'total counts' process, this would indicate that the design of the survey influences the total number of payments recorded in case the respondent did make a purchase. The results of the ZINB model are presented and discussed in Section 2.4.2.

As a final step, in Section 2.4.3 we use the ZINB estimation results for testing various hypotheses, in order to answer the six questions as formulated in Section 2.3.1. We use Wald tests to mutually compare the ZINB coefficients across various pairs of surveys and test whether the differing designs have a significantly different effect on the final payment estimates.

[7] There is a variation in this variable in all seven surveys, also in those where the respondents participated online. That is, the online respondents did not necessarily need to have internet access at home, as they were also able to participate at school or at work, which was the case for about 10% of the respondents.

2.4 Results

2.4.1 Objective validation of survey results

Table 2.4 shows the results of the validation exercise. There are, however, two caveats to keep in mind. First, the surveys' results and the actual debit card and cash data may not perfectly match, even when all respondents registered their payments accurately. That is, the two validation sources include payments from consumers who are excluded from our surveys, such as people older than 75 years, children and tourists. This might have led to coverage errors in all seven surveys, since these particular groups are generally more inclined to use cash (see Section 1.3 and references therein). As a result, all seven surveys may to some extent under- (over)estimate actual cash (debit card) usage. Second, regarding the cash estimates, some inequalities between the surveys and the validation data may be found due to the difference in the reference period. That is, the surveys were conducted in September 2007, whereas the retailers' cash data refer to 2006. Given the on-going substitution of cash by cards in the Netherlands (see Section 1.2.4), it seems only natural that the number and share of cash payments reported in the surveys are slightly lower than the validation data.

Turning to the validation of the cash estimates, Table 2.4 shows that the one-day diaries (Survey 1, 2, 4 and 5) slightly underestimate the daily number of cash payments. The downward differences, however, are small. Moreover, as explained above, part of this inequality is likely to be due to the exclusion of children, the elderly and other frequent cash users from the samples. Survey 4 and 5 reflect actual cash usage best. In fact, the outcomes of Survey 4 do not significantly differ from the actual data with respect to the average cash transaction value and the daily number of cash payments. Therefore, we will use Survey 4 as the benchmark in Section 2.4.2 when assessing the effect of survey design on the number of payments recorded. By contrast, the retrospective recall questionnaire (Survey 3) and the two one-week surveys (Survey 6 and Survey 7) signif-

Table 2.4: Validation of survey outcomes with actual payments data

	Actual data	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
Average daily no. payments per person:								
Total	**1.00**	0.98*	1.02*	0.91	1.05*	0.96*	0.70	0.72
		0.04	*0.04*	*0.04*	*0.04*	*0.04*	*0.02*	*0.02*
Cash	**0.72**	0.62	0.60	0.45	0.70*	0.64	0.44	0.46
		0.03	*0.03*	*0.03*	*0.03*	*0.04*	*0.02*	*0.02*
Debit card	**0.26**	0.34	0.40	0.42	0.32	0.31	0.26*	0.24
		0.02	*0.02*	*0.03*	*0.02*	*0.02*	*0.01*	*0.01*
Average transaction value (EUR):								
Total	**18.60**	21.34	23.19	27.34	19.32*	18.02*	23.07	23.98
		1.08	*1.31*	*2.50*	*0.99*	*0.84*	*1.14*	*1.71*
Cash	**9.60**	12.26	11.18*	14.40	11.50*	9.71*	12.82	15.51
		0.86	*1.12*	*0.90*	*0.99*	*0.47*	*1.12*	*2.01*
Debit card	**41.55**	38.30*	41.98*	38.11*	36.66	35.52	38.87*	36.41
		2.38	*2.81*	*5.15*	*2.20*	*2.05*	*2.13*	*1.88*

Note: This table presents the averages and standard errors (in italics) of the number and value of cash and debit card payments made per person per day as calculated based on 2006 cash data reported in EIM (2007) and September 2007 debit card data supplied by Currence (Column 1 in bold), and as estimated by the seven surveys (Columns 2 - 8). All data refer to retail trade payments only. * Denotes that the actual payments data fall within the 95% confidence intervals of the survey results. The survey data are weighted on the dimensions as explained in Section 2.3.3.

icantly suffer from underreporting of cash payments. About 37% of the cash transactions recorded in the one-day diaries are missed out in Survey 3, 6 and 7, hinting at the presence of recall errors. Given the relatively high average cash values, especially low value cash payments seem to be underreported.

Validation of the debit card results gives a different picture. Survey 6, and to some extent Survey 7, correspond very well with the actual number of debit card payments made. By contrast, the one-day surveys all overestimate it. This overestimation could possibly be related to the type of consumer panels used. The respondents to Survey 1, 2, 3 and 4 were all drawn from an online panel and therefore conceivably more 'electronically-minded' than the average population. However, the same overestimation is found in Survey 5 where the respondents were taken from a telephone panel. This suggests that the overestimation of debit card payments is more likely to be explained by other factors, for example, by measurement errors related to social desirability. Due to the nationwide campaigns in the Netherlands to encourage debit card payments, some respondents may have felt 'obliged' to use their debit card or to not be honest about their true debit card use. The higher probability of reporting a card payment when participating for one entire week may have reduced this tendency among the one-week participants in Survey 6 and Survey 7. In addition, the participants to the one-week surveys had more time to check their actual debit card payments on their bank statements. However, future research is to be recommended to further explore this overestimation of card payments in one-day surveys.

2.4.2 Influence of survey design on payments recorded

We used the ZINB model to estimate both the daily number of cash and the daily number of debit card payments reported by the respondents for different transaction values. The results of the cash models are presented in Table 2.5, whereas Table 2.6 shows the debit card outcomes. The co-

efficients of the 'always zero' process can be interpreted as those from a binomial logistic model, i.e. the expected changes in the log odds of being an excessive zero due to not having made a purchase at all. The coefficients of the 'total counts' process are to be interpreted as those of a negative binomial count model, with the expected daily number of recorded payments changing with *exp(coefficient)* for each unit increase in the explanatory variables.[8] The parameters α relaxing the equidispersion property of the standard Poisson model turned out to be significantly different from zero in both the cash and the debit card models. This confirms that the data are overdispersed and that the ZINB model is more appropriate than a Poisson model. In addition, we performed the Vuong test, which strongly rejected the standard negative binomial model in favour of the ZINB model, which supports our choice for using the ZINB model.

Table 2.5 and Table 2.6 show that, once corrected for consumer demographics and the day of the week, the survey method significantly influences the number of payments recorded by consumers. This holds for both the registration of excessive zeros and the total number of payments reported.[9] Table 2.5 demonstrates that the respondents to Survey 3, 6 and 7 reported significantly fewer cash payments than those in the reference survey, i.e. Survey 4 which, as shown in Section 2.4.1, reflects actual cash usage best. For instance, Column 2 shows that the expected daily number of reported cash payments in Survey 6 and Survey 3 is 0.562 (exp(-0.576)) and 0.748 (exp(-0.290)) times the expected daily number of reported cash payments in Survey 4. Survey 6 also yields significantly more excessive zero cash payments, i.e. the expected log odds of reporting zero cash payments due to not having made any purchase at all increases by 1.709 when participating in Survey 6 instead of in Survey 4 (see Column 1). The results of the trans-

[8]Note that the ZINB model is known for having estimation problems of the 'always zero' process. Some variables in our model seem to suffer from this. However, the coefficients referring to the impact of the survey method appear to have remained unaffected, as they turned out to be robust against alternative model specifications.

[9]To check for the robustness of the results, we re-ran the regressions without including the demographic variables. Overall, there were no substantial changes to our conclusions.

Table 2.5: The influence of survey method on cash payments reported

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All payments		EUR 0 - EUR 5		EUR 5 - EUR 15		EUR 15 and more	
	Always zero	Total counts	Always zero	Total counts	Always zero	Total counts	Always zero	Total counts
Survey method:								
Survey 1	−1.482	−0.063	−1.264	−0.067	0.291	−0.071	0.792	0.084
Survey 2	−0.837	−0.090	−2.305	−0.129	0.439	−0.037	1.562	−0.019
Survey 3	−0.133	−0.290***	0.123	−0.457***	0.570	−0.375***	1.913	0.377
Survey 5	−16.270***	−0.029	−3.520	−0.037	0.762	0.030	2.704	0.261
Survey 6	1.709**	−0.576***	1.387	−0.682***	1.318**	−0.555***	2.557	−0.202
Survey 7	1.233	−0.655***	0.767	−0.741***	1.484	−0.594***	2.656	−0.286
Day of the week:								
Tuesday	0.868	0.223***	−0.301	0.218***	14.254***	0.183**	0.269	0.152
Wednesday	1.254*	0.256***	0.762	0.265***	13.863**	0.229**	0.133	0.181
Thursday	0.701	0.275***	−0.021	0.208***	2.262	0.250***	0.665	0.472*
Friday	1.106	0.434***	0.201	0.271***	14.239***	0.483***	−0.876	0.410
Saturday	1.112	0.552***	0.692	0.355***	12.885	0.636***	−0.082	0.693
Sunday	2.158**	−0.250*	1.879**	−0.169	18.610***	0.205	0.529	−0.232
Female	−0.449	0.210***	−0.956**	0.119**	1.394	0.336***	−0.873	0.058
Region:								
North	0.906	0.044	0.731	0.060	−0.069	−0.077	−0.002	0.018
East	0.849	−0.025	0.841	−0.002	0.291	−0.077	−0.342	−0.163
South	−0.834	−0.051	−0.654	−0.063	−0.694	−0.079	0.836	0.247
Age:								
12 - 17	2.299*	−0.400***	2.334*	0.200*	−1.517	−1.380***	−1.300	−1.774**
18 - 29	−0.496	−0.473***	−0.597	−0.318***	−1.062	−0.608***	0.555	−0.527**
30 - 39	−0.400	−0.354***	−0.503	−0.285***	−1.524	−0.451***	1.677	−0.030
40 - 49	0.089	−0.241***	0.152	−0.176**	−1.618	−0.400***	0.979	−0.045
50 - 59	−0.586	−0.228***	−0.293	−0.162**	−1.185	−0.329***	−0.361	−0.239
Education:								
Primary	0.111	0.091	−13.390***	−0.354***	−3.745	0.336**	0.036	0.210
Lower secondary	0.219	0.127	0.469	−0.037	−0.680	0.306***	−0.322	0.185
Intermediate secondary	0.452	0.158**	0.541	0.025	−0.584	0.301***	−0.091	0.211
Higher secondary	−2.278	−0.028	−2.245	−0.143*	−0.542	0.111	−0.767	0.007
Internet at home	0.004	0.240***	0.450	0.209**	−0.054	0.310***	0.008	0.212
Constant	−4.581**	0.087	−3.468	−0.457**	−18.160***	−1.152***	−3.814	−1.706***
No. Observations		11,461		11,461		11,461		11,461
Wald chi2(26)		470.54		328.42		619.73		217.12
Prob. > chi2		0.0000		0.0000		0.0000		0.0000

Note: This table presents the coefficients of various ZINB model specifications. The dependent variable is the daily number of cash payments recorded by the respondents for various transaction values. The reference category is a cash payment made on a Monday by a male from the western part of the country, participating in Survey 4, with a masters degree, aged 60 years and more, without internet access at home. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

Table 2.6: The influence of survey method on card payments reported

	(1)	(2)	(3)	(4)	(5)	(6)
	All payments		EUR 0 - EUR 15		EUR 15 and more	
	Always zero	Total counts	Always zero	Total counts	Always zero	Total counts
Survey method:						
Survey 1	0.544	0.130	−0.159	0.076	0.324	0.086
Survey 2	−0.033	−0.026	−0.211	−0.081	−0.746	−0.094
Survey 3	−0.351	0.146	−0.615	−0.041	−0.268	0.173
Survey 5	0.276	−0.018	−1.322*	−0.267	0.472	−0.021
Survey 6	2.030***	−0.183**	1.243*	−0.090	1.643***	−0.255
Survey 7	1.868***	−0.266**	0.959*	−0.202	1.540**	−0.348*
Day of the week:						
Tuesday	0.663*	0.160	0.627	0.260	1.152**	0.247*
Wednesday	0.427	0.336***	0.111	0.183	1.146**	0.536***
Thursday	0.013	0.300***	−0.120	0.261	0.586	0.394***
Friday	−0.310	0.496***	−0.589	0.107	0.195	0.699***
Saturday	−0.316	0.506***	−0.661	0.118	−0.225	0.636***
Sunday	1.293***	−0.535***	1.854**	−0.388	1.284	−0.441
Female	−0.607**	0.158**	−0.955***	−0.001	−0.793	0.100
Region:						
North	−0.377	−0.114	−0.466	−0.146	−0.978**	−0.244***
East	−0.129	−0.146*	−0.001	−0.097	−0.424	−0.218***
South	0.132	−0.082	0.106	−0.162	−0.177	−0.116
Age:						
12 - 17	2.844***	0.178	3.042**	1.336***	4.172*	0.202
18 - 29	0.765	0.278***	1.039	1.057***	1.543	0.124
30 - 39	−0.353	0.183*	0.532	0.825***	0.192	0.091
40 - 49	0.542	0.297***	0.997	0.767***	1.435	0.361**
50 - 59	0.280	0.171*	1.633	0.777***	0.526	0.153
Education:						
Primary	0.972*	0.059	−0.443	−0.225	0.682	−0.210
Lower secondary	−0.355	0.023	−0.011	0.160	−0.386	0.009
Intermediate secondary	−0.436	0.046	−0.413	0.081	−0.368	0.033
Higher secondary	−0.711**	0.057	−0.370	0.130	−0.677	0.062
Internet at home	−0.987**	0.184	−1.357*	0.011	−0.819	0.150
Constant	−1.289*	−1.034***	0.208	−2.125***	−1.832*	−1.320***
No. Observations		11,461		11,461		11,461
Wald chi2(26)		116.96		51.32		158.68
Prob. > chi2		0.0000		0.0022		0.0000

Note: This table presents the coefficients of various ZINB model specifications. The dependent variable is the daily number of debit card payments recorded by the respondents for various transaction values. The reference category is a debit card payment made on a Monday by a male from the western part of the country, participating in Survey 4, with a masters degree, aged 60 years and more, without internet access at home. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

action value-specific models (Columns 3 - 8) show that the gap between Survey 3, 6 and 7 on the one hand and Survey 4 on the other is largest for the smallest transactions and that the differences become insignificant for cash payments of EUR 15 and higher. This confirms the inferences made in the literature that retrospective recall questionnaires and multiple-day diaries suffer from incomplete recall of in particular small and non-salient events. In fact, our results show that for measuring low value cash payments, one-day diaries provide more accurate information.

Regarding the number of debit card payments (Table 2.6), we find that the participants to Survey 6 and 7 reported significantly fewer transactions than those to Survey 4. Moreover, the former are also more likely to have reported excessive zeros. This corresponds to the earlier finding in Section 2.4.1 of Survey 4 and the other one-day surveys overestimating debit card usage. Given the short length of the recall period (i.e. one day) and the fact that the respondents were drawn from both online and telephone panels, this overestimation is not likely to be caused by telescoping or the sampling method. Instead, the deviations may be explained by a certain form of social desirability, i.e. the desire to report a debit card payment. However, as mentioned in Section 2.4.1, future research would be valuable to further explore this overestimation of card use in one-day surveys.

2.4.3 Hypothesis tests

Overall, the results show that consumer surveys measuring the use of payment instruments are vulnerable to errors. In particular, we find that surveys measuring the number of cash payments may suffer from underreporting of especially low value transactions. Moreover, we find indications that the way the survey is designed is of great importance to the final outcomes. In this section, we further assess the impact of the design of the survey by examining to what extent the different survey methods suffer from online selection biases, recall errors, social desirability errors and telescoping errors. To this end, we turn to answering the questions formulated

in Section 2.3.1 by using the ZINB estimation results for testing various hypotheses.[10] The results of the hypothesis tests are summarised in Table 2.7 and allow us to answer the questions as follows:

Question 1 *Does combining a retrospective recall questionnaire with a payment diary (Survey 1) lead to different payment estimates compared to merely using a retrospective recall questionnaire (Survey 3)?*

Table 2.7 shows that the hypothesis that the respondents to Survey 1 are as likely to have registered excessive zero cash and debit card payments as those in Survey 3 cannot be rejected. The data do, however, reject at the 1% significance level the hypothesis that those in Survey 1 reported as many cash payments given that they had made at least one purchase. In particular, the people participating in Survey 3 reported significantly fewer cash transactions of EUR 15 and lower. We find no significant differences for payments of EUR 15 and higher. This demonstrates that the retrospective recall questionnaire suffers from incomplete recall of low value cash payments. This is in line with the general conclusions drawn in the literature of non-salient events being vulnerable to underreporting (see Section 2.2.1). Our results further correspond to the related literature by showing that this underreporting can significantly be reduced by using a payment diary. Finally, the insignificant differences for payments of EUR 15 and higher suggest that the retrospective recall questionnaire does not significantly suffer from telescoping errors in terms of higher value payments being overreported.

Question 2 *Does combining a payment diary with a retrospective recall questionnaire (Survey 1) lead to different payment estimates compared to merely using a payment diary (Survey 4)?*

[10] Instead of using the ZINB coefficients of each of the seven surveys as presented in Table 2.5 and Table 2.6, we could have re-run the regressions including dummy variables for each particular survey feature and have used these coefficients. However, since the current comparisons are based on pairs of surveys that differ from each other on one particular feature only, the conclusions would be similar.

The test results of both the cash and the debit card model show that neither hypothesis, i.e. that of no difference in having recorded excessive zeros and that of no difference in the total number of recorded payments, can be rejected at the 5% level. As the nature of the questionnaire may play a role here, the third research question reads as follows:

Question 3 *Do retrospective telephone questionnaires (Survey 2) lead to different payment estimates compared to retrospective online questionnaires (Survey 1)?*

Again, neither hypothesis can be rejected at the 5% level, which shows that additional recall questionnaires, regardless of being conducted by phone or online, do not significantly reduce recall error (if any) in payment diaries. Moreover, contrary to the conclusions drawn in the literature, we do not find evidence of the telephone recall questionnaire suffering from social desirability errors in terms of a higher number of card or a lower number of cash payments being reported than in the online questionnaire. These two findings may be explained by the use of the payment diary prior to the recall questionnaire, which may have already prevented recall and social desirability errors from occurring, due to which they are no longer present in the subsequent recall questionnaire.

Question 4 *Do respondents drawn from online consumer panels (Survey 2) report different payment choices compared to respondents taken from a telephone panel (Survey 5)?*

The test results in Table 2.7 do not show any sign of a higher (lower) number or share of card (cash) payments in Survey 2 for either small or large value payments.[11] These findings suggest that consumers participating in online panels do not, as asserted by Bethlehem (2010), differ significantly from

[11] We did not find any significant differences in the total number of payments recorded for either small or large value payments. The results did differ on the number of excessive zeros. However, these differences become insignificant when making a distinction based on transaction value.

the overall population in terms of cash and debit card use. This finding may, however, be characteristic of the Netherlands, which is characterised by a relatively high level of internet access.[12] Countries having a low(er) internet penetration may therefore still suffer from biases related to the use of online panels.

Question 5 *Does the length of the diary registration period affect the outcomes of a payment diary (Survey 5 versus Survey 7)?*

The hypothesis tests demonstrate that the duration of the registration period significantly influences consumers' registration of low value cash payments. The hypothesis of no difference in the daily number of recorded cash payments between the one-day diary (Survey 5) and the one-week diary (Survey 7) is rejected at the 1% level for payments up to EUR 15. This confirms the general conclusions in the literature and shows that one-week diary surveys are vulnerable to incomplete recall of, in particular, non-salient events due to diary fatigue and diary despair. We do not find evidence of the one-week diary being subject to telescoping errors in terms of significant overreporting of higher value payments.

Question 6 *Do interim reminders improve the survey outcomes of multiple-day payment diaries (Survey 6 versus Survey 7)?*

The hypothesis tests show no significant differences between Survey 6 and Survey 7. Neither the hypothesis of no difference in having recorded excessive zero payments, nor the hypothesis of no difference in the total number of recorded payments is rejected by the data. This indicates that the above signalled incomplete recall error in the one-week payment diary is not reduced when using an interim reminder.

[12] At the time of the survey, around 90% of Dutch households had internet access, which was relatively high compared to the European average of 65% (Eurostat Statistics, 2009, available at: www.eurostat.ec.europa.eu).

Table 2.7: Results of hypothesis tests

			Cash model				Debit card model		
		Test on equality of:	All payments	EUR 0 - 5	EUR 5 - 15	EUR 15 and more	All payments	EUR 0 - 15	EUR 15 and more
Question 1	Survey 1 vs. Survey 3	Total counts	$p = 0.01$	$p = 0.01$	$p = 0.00$	$p = 0.53$	$p = 0.87$	$p = 0.74$	$p = 0.42$
		Always zeros	$p = 0.30$	$p = 0.29$	$p = 0.78$	$p = 0.45$	$p = 0.32$	$p = 0.79$	$p = 0.39$
Question 2	Survey 1 vs. Survey 4	Total counts	$p = 0.23$	$p = 0.40$	$p = 0.37$	$p = 0.57$	$p = 0.14$	$p = 0.75$	$p = 0.40$
		Always zeros	$p = 0.29$	$p = 0.17$	$p = 0.76$	$p = 0.85$	$p = 0.24$	$p = 0.83$	$p = 0.50$
Question 3	Survey 1 vs. Survey 2	Total counts	$p = 0.68$	$p = 0.40$	$p = 0.67$	$p = 0.84$	$p = 0.13$	$p = 0.53$	$p = 0.08$
		Always zeros	$p = 0.68$	$p = 0.49$	$p = 0.87$	$p = 0.72$	$p = 0.51$	$p = 0.95$	$p = 0.26$
Question 4	Survey 2 vs. Survey 5	Total counts	$p = 0.43$	$p = 0.19$	$p = 0.45$	$p = 0.75$	$p = 0.95$	$p = 0.38$	$p = 0.57$
		Always zeros	$p = 0.00$	$p = 0.79$	$p = 0.74$	$p = 0.30$	$p = 0.71$	$p = 0.13$	$p = 0.24$
Question 5	Survey 5 vs. Survey 7	Total counts	$p = 0.00$	$p = 0.00$	$p = 0.00$	$p = 0.29$	$p = 0.08$	$p = 0.82$	$p = 0.12$
		Always zeros	$p = 0.00$	$p = 0.40$	$p = 0.60$	$p = 0.98$	$p = 0.01$	$p = 0.00$	$p = 0.12$
Question 6	Survey 6 vs. Survey 7	Total counts	$p = 0.23$	$p = 0.48$	$p = 0.63$	$p = 0.76$	$p = 0.38$	$p = 0.62$	$p = 0.31$
		Always zeros	$p = 0.26$	$p = 0.13$	$p = 0.87$	$p = 0.91$	$p = 0.60$	$p = 0.56$	$p = 0.72$

Note: This table presents the p-values of the Wald tests performed to test for equality of the estimated ZINB coefficients for the various survey methods.

2.5 Conclusions

Knowing how to best measure the use of cash is of great importance for further stimulating the overall cost efficiency of retail payments. In particular, as cash is still heavily used for the smallest transactions, insight into the number and characteristics of these low value payments is essential, as it allows for a better understanding of consumers' motivations for using cash, and, hence, of what potential measures to take to further foster the use of the most socially cost efficient payment instruments. Moreover, reliable data on the use of cash at such a detailed level are essential to measuring the total costs of payments, as incorrect data may lead to incorrect conclusions on the costs of cash to society.

Therefore, the aim of this chapter was to assess what survey methodology is best suited to estimate the total number of cash payments made by consumers. To this end, we employed a unique set of transaction records collected among 5,400 consumers using seven different survey methods and we used actual payments data from retailers and the owner of the Dutch debit card scheme to validate the surveys' results. In addition, we estimated a Zero Inflated Negative Binomial (ZINB) model to study the impact of the survey method on consumers' ability to recall and report all of their payments. Overall, we find that consumer surveys are suitable for collecting accurate cash data. However, we do show that the survey method and the duration of the survey period clearly influence the estimates.

We conclude that the quality of cash estimates benefits from using a self-reported payment diary. By contrast, we demonstrate that retrospective recall questionnaires suffer from underestimation of cash payments. In particular, consumers tend to forget their low value cash payments when being asked to recall their payments by heart. Second, we find that about 40% of the payments registered in a one-day diary, and especially the low value payments, are missed out in a one-week diary. This problem is not reduced when using an interim reminder. Therefore we conclude that the best way to measure consumers' payment choices, and in particular their use of

cash, is to ask consumers to register their daily purchases in a payment diary for one single day. Herewith our results confirm the general conclusions drawn in the related literature as described in Section 2.2.1, that recall questionnaires and multiple-day diaries may suffer from incomplete recall of, in particular, non-salient events. As opposed to earlier papers, we do not find evidence of selection biases when selecting respondents from an online instead of a telephone panel.

Given this background, in Chapter 3 of this thesis we will conduct a one-day payment diary survey in order to analyse the role of foreign background in consumers' payment choices. However, the results of our validation exercise suggest that one-day diaries may suffer from an overestimation of debit card payments. This may possibly be caused by social desirability error, but future research is to be recommended to explore this issue in more detail. Meanwhile, we will slightly adjust the questioning and wording in the survey used in Chapter 3, so to encourage the respondents to be honest about and to not change their regular debit card use.

Apart from measuring cash payments in the Netherlands, our findings may have wider applicability. The conclusion that one-day diaries are to be preferred as opposed to multiple-day diaries and recall questionnaires is in line with the earlier literature showing evidence of the latter ones suffering from diary fatigue, diary despair and underreporting of non-salient events. Therefore, the findings are likely to apply to other countries too. Moreover, the conclusions may also be useful for other fields of research that aim at measuring events or decisions that are easily forgotten. Our finding that respondents from online panels do not behave differently than people from telephone panels, however, may not necessarily have wider applicability, as the Netherlands is characterised by a relatively high level of internet access. Therefore, similar studies conducted in countries with a low(er) internet penetration may still be vulnerable to biases due to online panel members being more 'electronically-minded' than the average population.

Chapter 3

Role of foreign background in consumer payment choice[1]

Is having a foreign background a relevant factor in choosing between payment instruments at the point-of-sale? We analyse this question using a unique diary survey in which both consumers with a Dutch and a foreign background documented their daily purchases. We present several pieces of evidence suggesting that foreign backgrounds still influence the choice between payment instruments after migration. For instance, we find that first-generation migrants from a number of countries that can be seen as cash-oriented are more likely to use cash in the Netherlands as well. At the same time, we show that second-generation migrants have similar payment habits as individuals with a Dutch background. These findings suggest that the differences in payment choices are not caused by generic migrant-related barriers or passed on between generations, but the result of payment habits in the country in which a person has grown up.

[1]This chapter is based on Kosse, A. and Jansen, D. (2013), Choosing how to pay: The influence of foreign backgrounds, *Journal of Banking & Finance* 37(3): 989-998.

'Habit is stronger than reason'
Aristotle (384 BC - 322 BC)

3.1 Introduction

The payments literature as summarised in Chapter 1 suggests that consumers' choice which payment instrument to use depends on various factors, such as consumer demographics, as well as transaction, location and payment instrument-related characteristics. However, the literature has, so far, paid little attention to the payment behaviour of consumers having a foreign background, i.e. consumers whose parents are born abroad. Therefore, this chapter studies whether the choices between payment instruments made by individuals with a foreign background are in any way different than those of the native population, and if so, to what extent these differences can be explained by the payment habits in their countries of origin. To this end, we conducted an extensive diary survey among 2,258 residents of the Netherlands with either a Dutch or a foreign background, using the survey method as suggested in Chapter 2. By combining this unique dataset with national payment statistics collected by the World Bank (2008), we shed light on the effect of home-country payment habits on consumers' payment behaviour after migration. In doing so, this chapter makes it possible to gain deeper understanding of whether there is room for a further increase in the use of electronic payment instruments in order to foster the overall social cost efficiency of the payment system. In addition, it allows for a better understanding of the underlying reasons of consumers' choices, and, hence, of what potential measures to take to stimulate electronic ways of paying.

This chapter relates to earlier work that reports differences in payment behaviour based on race or ethnicity (e.g. Borzekowski and Kiser (2008), Borzekowski et al. (2008), Ching and Hayashi (2010), Schuh and Stavins (2010), Mann (2011)). However, these papers do not have detailed informa-

tion on respondents' country of origin. A second key difference is that they do not distinguish between different generations. By contrast, we are able to distinguish between first and second-generation migrants and to assess whether payment preferences differ between generations.

The remainder of this chapter is structured as follows. Section 3.2 presents some background information about the major migrant groups living in the Netherlands, as well as a selective review of the relevant literature and the main research questions. Section 3.3 describes the methodology and data, while Section 3.4 analyses the role of foreign backgrounds in choosing between payment instruments. Finally, Section 3.5 summarises and concludes.

3.2 Background and research questions

3.2.1 Migrants in the Netherlands and home-country habits

Residents with a foreign background make up around 20% of the Dutch population.[2] Since years, migrants from non-western countries have made up the largest share, with the majority originating from Turkey and Morocco, followed by Suriname, the Netherlands Antilles[3] and Aruba (see Table 3.1). Migration from Turkey and Morocco started in the 1960s, when there was a high demand for low-skilled workers which could not be fulfilled by the immigrant workers from Spain and Italy. Many of the Turkish and Moroccan workers stayed and their families migrated to the Netherlands during the subsequent decades (Kok et al. (2011)). For instance, it is estimated that 65,000 Turkish migrants came to the Netherlands in the 1960s and early 1970s. They often came from Mid- and Southern Turkey, where the unemployment rate was generally at a high level (CGM (2012)).

[2]This estimate by Statistics Netherlands refers to the Dutch population of 15 years and older in 2008 of which at least one of the parents is not born in the Netherlands.

[3]Since 2010, the Netherlands Antilles is no longer an autonomous country within the Kingdom of the Netherlands. Nevertheless, in this chapter, we use the term Netherlands Antilles in order to refer to the islands of Bonaire, Curaçao, Saba, Sint Eustatius and Sint Maarten.

Table 3.1: Dutch population by ethnicity (2008)

Background	**Population** (15 years and older)	**%**
Turkey	271,660	21%
Morocco	227,809	18%
Suriname, Netherlands Antilles, Aruba	365,558	28%
Other non-western	426,318	33%
Total non-western	**1,291,345**	**100%**
Of which:		
1st generation	*973,214*	*75%*
2nd generation	*318,131*	*25%*
Indonesia	368,447	29%
Germany	346,510	27%
Eastern Europe	185,386	15%
Other western	360,851	29%
Total western	**1,261,194**	**100%**
Of which:		
1st generation	*569,030*	*45%*
2nd generation	*692,164*	*55%*
Total immigrants	2,552,539	19%
Total native population	10,917,136	81%
Total Dutch population	**13,469,675**	**100%**

Note: Statistics Netherlands, 2008.

The inflow of Surinam migrants started in the 1950s and mainly concerned young people who came to study. Since the mid-1970s, however, migration from Suriname has mainly been driven by other reasons, such as better job opportunities and political reasons. In 1975 alone, the prospect of independence led around 40,000 people to migrate to the Netherlands (CGM (2012)). The migration pattern from the Netherlands Antilles shows similar patterns. Initially, Antilleans came to the Netherlands to take up a study, but as from the mid-1990s more Antilleans have migrated to the Netherlands in the hope of finding prosperity (CGM (2012)).

The largest share of western immigrants originates from Indonesia (the

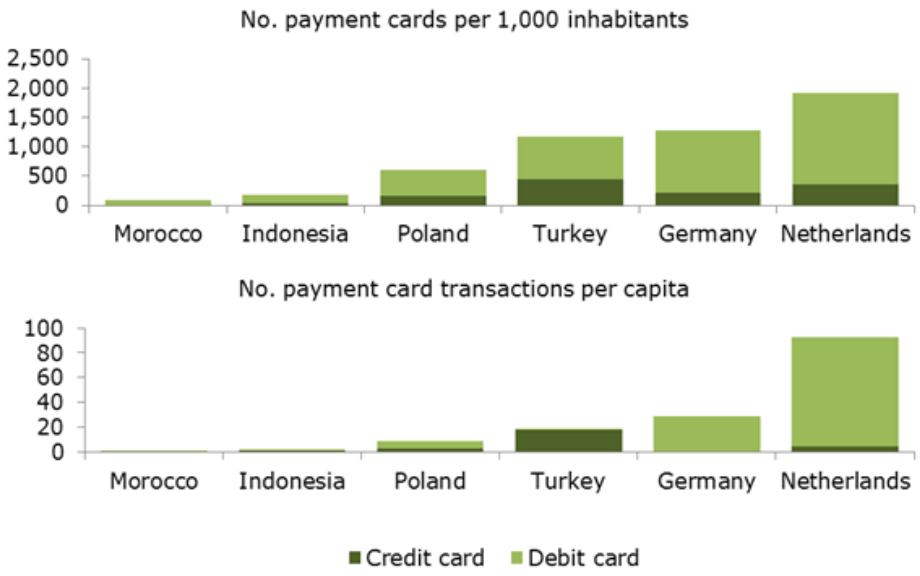
then Netherlands East Indies). The official classification by Statistics Netherlands of Indonesia as a western country is strongly related to the colonial linkages between Indonesia and the Netherlands. In fact, many individuals from Indonesia originally have a Dutch background. We will return to this issue in Section 3.3. Many Indonesians came to the Netherlands after the decolonisation of Indonesia directly after the Second World War (CGM (2012)). Germans make up the second largest group of western immigrants, followed by people from other European countries. Especially the share of migrant workers from Eastern Europe has strongly increased since the entry of Poland, Bulgaria and Romania into the European Union. Since a few years, Poland constitutes the fastest growing group of migrants (CGM (2012)).

For some migrant groups, POS payment habits in their home countries differ substantially from those in the Netherlands. To examine this, ideally, one would like to use a consistent set of cross-country data on cash and card use. However, as for most countries data on cash usage are lacking, we collected data on the use and possession of payment cards as an indicator of a country's reliance on cash. As far as we are aware, the data provided by the World Bank (2008) is the best candidate source for our purposes, as it covers nearly all the countries represented in our sample. Figure 3.1 presents two relevant indicators: the number of payment cards per 1,000 inhabitants and the number of payment card transactions per capita. It compares data for the Netherlands with those for the home countries of the major migrant groups living in the Netherlands.[4]

Figure 3.1 confirms the conclusion drawn in Chapter 1 that debit cards are used extensively in the Netherlands. In 2006, the Dutch owned on average 1.6 debit cards per person and they used their debit card about 90 times a year. Despite being a neighbouring country, payment behaviour in

[4]Despite its broad coverage, unfortunately, Suriname is not taken up in the World Bank dataset and the two indicators were not available for the Netherlands Antilles and Aruba. We tried to obtain further data for these countries from other sources, but without success. Consequently, they are not presented in Figure 3.1 and, hence, no conclusions can be drawn regarding the payment habits in these countries.

Figure 3.1: Payment card possession and usage in different countries (2006)



Note: Data are taken from the World Bank, Payment Systems Worldwide, a Snapshot, Outcome of the Global Payment Systems Survey, 2008 (World Bank (2008)). Unfortunately, data for Suriname, the Netherlands Antilles and Aruba are not available.

Germany substantially differs. Most Germans own a debit card, but they use it less extensively than the Dutch. On average, Germans made 29 card payments per person in 2006, which suggests that they more often pay in cash. The reliance of German consumers on cash has also been established elsewhere in the literature (e.g. von Kalckreuth et al. (2009)). In Morocco, Indonesia, Poland and Turkey too, payment cards are significantly less often used, which again points to a greater cash use.

3.2.2 Related literature

The payments literature as summarised in Chapter 1 has, so far, paid little attention to payment choices of migrants. There are a few papers that report differences in payment behaviour based on race or ethnicity.

Ching and Hayashi (2010) find that Asians are less likely to pay by card in the United States than African Americans, Caucasians, Hispanics and Americans. Borzekowski and Kiser (2008), Borzekowski et al. (2008) and Schuh and Stavins (2010) also point to significant differences, with non-white Americans having a higher preference for electronic payment instruments and Latinos writing more cheques than white consumers. On the contrary, Mann (2011) concludes that the range of electronic payment instruments used in the United States by non-whites is narrower than that by whites. These papers, however, often only use race or ethnicity as an additional variable when analysing consumer choices, without exploring its role in further detail.

The role of foreign backgrounds has been studied more extensively in other fields. A dimension that receives increasing attention is migrant participation in financial markets more generally, and the conclusions in this area provide several indications that payment choices too may differ between population groups. Overall, immigrants tend to be less 'banked' than the native population, which may imply that they rely more strongly on cash. Osili and Paulson (2009), for example, show that migrants are less likely to own a savings or a checking account compared to the native-born. Similarly, Jankowski et al. (2007) analyse currency demand in Chicago and find that Latin Americans demand more USD 100 bills than other residents. Since these bills are mainly held as a store of value instead of for payment purposes, the results may either indicate barriers faced by Latin American immigrants or their reluctance to open and use a bank account. Also, Campbell, Martínez-Jerez and Tufano (2012) find that involuntary bank account closure is higher in countries with large black populations and lower in counties with Hispanic and Asian populations. Although the effects are sizeable, the paper does not provide any further explanation for these findings.

Regarding the potential effect of home-country habits, there is evidence that the culture of the country of origin influences behaviour of migrants

in host countries. Osili and Paulson (2008), for example, find that immigrants from countries with more effective institutions are more likely than others to have a relationship with a bank and to extensively use formal financial markets. Jankowski et al. (2007) and Osili and Paulson (2009) too claim that immigrants from countries having a strong institutional environment may be more likely to have a bank account in their host country, whereas immigrants having experienced financial crises might be less likely to participate in the host-country's financial system. The importance of home-country culture and habits is also found in the area of labour force participation. For instance, Kok et al. (2011) and Antecol (2000) find that a high female participation rate in the home country correlates with a high female participation rate in the host country. Both papers also show that the first generation is more affected by its home-country culture than the second generation. This suggests that the effect of home-country habits diminishes over generations and that the behaviour of migrants gradually converges to that of the native population. Similar evidence of cultural assimilation is found in the area of education. Hlaimi and Wolff (2007) and Gang and Zimmermann (2000), for instance, show that differences in educational attainment levels between migrants and their comparable native cohorts are smaller for the second than for the first generation.

3.2.3 Research questions

Given the background provided above, the main objective of this chapter is to study whether having a foreign background is a relevant factor in choosing between payment instruments at the POS after migration. To this end, the two main research questions are: *"Do POS payment choices of consumers differ according to their country of origin and generation?"* and *"To what extent are these payment choices influenced by home-country payment habits?"*.

Considering the substantial differences in payment behaviour between the Netherlands and the different countries of origin, as well as the various

indications from the literature that home-country habits affect behaviour after migration, we may expect consumers' payment choices to significantly vary by country of origin. Also, following the conclusions in the literature on cultural assimilation, we may expect to find these differences to be largest for the first generation, i.e. those who were born and have grown up abroad.

3.3 Methodology and data

3.3.1 Survey design and data collection

To answer the two research questions formulated in Section 3.2.3, we conducted an extensive survey among residents of the Netherlands. The data collection was carried out by the research agency Veldkamp and took place between March and July 2009. The survey aimed to gather sufficient data on the major ethnicity groups living in the Netherlands. In defining these groups, we relied on the official classifications of Statistics Netherlands (see Table 3.2). These classifications are commonly used in Dutch policy debates, as well as in other papers, for instance in Kok et al. (2011). To classify individual countries, Statistics Netherlands primarily takes into account their social-economic and social-cultural similarities to the Netherlands, and to a lesser extent their geographical locations. Therefore, some countries are classified under a different category than one would initially expect based on their geographical position.

The first group our survey targeted were individuals with a Dutch background, which means that both parents are born in the Netherlands. The aim was to have at least 400 individuals for this group. This target was set in order to be able to draw valid conclusions regarding the true number of payments made by the total native population in the Netherlands, based on a 95% confidence level and a 5% confidence interval. The second group were individuals with a foreign background, meaning that at least one of the parents is not born in the Netherlands. Within this group, two

further subdivisions can be made. If the person itself is born outside the Netherlands as well, he or she is classified as a first-generation individual with a foreign background. If the country of birth is the Netherlands, then he or she is seen as second-generation. A second distinction is that between western and non-western. For first-generation individuals, if the country of birth is in Europe (excluding Turkey), North America, Oceania, Indonesia or Japan, that person is classified as having a western background. If they are born in Africa, South America, Asia (excluding Indonesia and Japan) or Turkey, they are classified as non-western. For second-generation persons with foreign backgrounds, the distinction between western and non-western is first based on the country of birth of the mother. If the mother is born in the Netherlands, then the father's birthplace is used. The aim was to have at least 400 persons with a western, and 1,200 individuals with a non-western background. The sample of non-westerners was selected in such a

Table 3.2: Classification of foreign backgrounds

Description	**Criteria**	
	Country of birth	Country of birth parents
Dutch background	Not relevant	The Netherlands
Foreign background		
1st generation	Outside the Netherlands	At least one born outside the Netherlands
2nd generation	The Netherlands	At least one born outside the Netherlands
Foreign background		
Western	Europe (excl. Turkey), North America, Oceania, Indonesia or Japan	
Non-western	Africa, South America, Asia (excl. Indonesia and Japan) or Turkey	

Note: This table provides information on the official classification of individuals with foreign backgrounds, as defined by Statistics Netherlands (www.cbs.nl).

way that the four major countries of origin were adequately represented. As a result, the data allow for drawing valid conclusions regarding the true payment behaviour of the western and the Turkish, Moroccan, Surinam and Antillian population in the Netherlands, based on a 95% confidence level and a 5% confidence interval.

Ethnic minorities are usually underrepresented in consumer surveys due to the complexity and high costs of reaching and approaching them. Also, the rate of response is often low (Schmeets and van der Bie (2006)). In order to accommodate to the specific characteristics and attitudes of these groups and to minimise non-response, we used a combination of survey techniques. Respondents with a Dutch and a western background were mainly selected using an internet panel. This group also answered the questionnaire online. Although the results in Chapter 2 showed that consumers participating in online panels do not significantly differ from the overall population in terms of debit card use, we did contact a group of non-internet users by letter, to be entirely sure that our data would not suffer from any electronic biases. If they were willing to participate, they were subsequently approached for face-to-face interviews.

Virtually all respondents with a Turkish, Moroccan, Surinam and Antillean background were selected using a quota procedure, where the interviewers used their own networks and visited specific places with a high probability of encountering the targeted respondents. The Surinam and Antillean respondents were subsequently surveyed in a face-to-face interview. Respondents with a Moroccan and Turkish background, however, were more reluctant about participating face-to-face, even if the interviewers had a Moroccan or Turkish background. In particular, the respondents had reservations about providing personal and financial information. Also, there was fear of making mistakes because of insufficient command of the Dutch language. To address these concerns, paper-based interview techniques were used for these particular groups. As discussed in Chapter 2, consumers' registration of payments may be affected by the particular sur-

vey method used. However, given the consistency in survey setup, design and length, the effects of using online, face-to-face as well as paper-based techniques are expected to be limited.

Irrespective of the interview techniques used, for all respondents the survey consisted of two parts. First, in order to assess their daily payment behaviour, we followed the conclusions and recommendations presented in Chapter 2 and requested the respondents to document all their POS expenses during one day in a payment diary. To reduce any potential overestimation of card use, we explicitly asked them not to deviate from their regular payment behaviour. For each transaction made, the respondents were asked to register the time of the purchase, the location, the method of payment used and the transaction amount. Regarding the location, a pre-defined set of twenty types was given. The second part of the survey contained a list of detailed background questions on demographics, attitudes and perceptions regarding the various payment instruments.

3.3.2 Key statistics

Table 3.3 presents an overview of the characteristics of the survey participants. The target number of respondents was met for all population groups. The final sample includes 620 individuals with a Dutch background and 1,638 respondents with a foreign background. Column 2 summarises the consumer characteristics for all 2,258 individuals. As a benchmark, Column 1 and the last line of the table present information on the Dutch population based on data from Statistics Netherlands. Columns 3 to 8 present a breakdown based on backgrounds.

First, Table 3.3 shows that the full sample differs on a number of dimensions from the Dutch population. On average, the respondents are younger, more often female, less highly educated, and more likely to live in an urban environment in the western part of the Netherlands. Also, given the survey design, persons with a foreign background are overrepresented. Given these differences, we constructed sampling weights based on gender,

Table 3.3: Characteristics of survey participants

	(1) Population	(2) Full sample	(3) Background Dutch	(4) Foreign	(5)	(6)	(7)	(8)
				All	Western		Non-western	
					1st gen.	2nd gen.	1st gen.	2nd gen.
Female	0.50	0.53	0.54	0.53	0.56	0.53	0.52	0.52
Age	46.9	41.4	48.4	38.7	50.0	48.1	42.0	26.5
Education:								
None	0.01	0.04	0.01	0.04	0.02	0.00	0.09	0.01
Primary	0.08	0.15	0.12	0.16	0.03	0.11	0.23	0.13
Secondary	0.65	0.60	0.61	0.59	0.59	0.63	0.55	0.63
BA	0.16	0.17	0.20	0.15	0.22	0.18	0.10	0.19
MA	0.09	0.05	0.05	0.05	0.15	0.07	0.04	0.04
Income (EUR):								
None		0.09	0.08	0.09	0.04	0.07	0.09	0.12
Less than 1000		0.27	0.22	0.29	0.29	0.21	0.26	0.37
1000-2000		0.33	0.32	0.33	0.34	0.27	0.42	0.25
2000-3000		0.19	0.22	0.17	0.15	0.26	0.15	0.14
More than 3000		0.13	0.16	0.12	0.18	0.19	0.08	0.12
With partner	0.62	0.64	0.66	0.63	0.83	0.79	0.71	0.40
Urban	3.0	3.8	3.2	4.0	3.7	3.5	4.2	4.2
Region of residence in NL:								
West	0.46	0.58	0.43	0.64	0.56	0.51	0.66	0.70
North	0.11	0.06	0.10	0.05	0.11	0.05	0.05	0.03
East	0.21	0.16	0.20	0.14	0.20	0.15	0.13	0.14
South	0.22	0.20	0.27	0.17	0.13	0.29	0.16	0.13
Bank account in NL?		0.98	1.00	0.97	0.99	1.00	0.96	0.97
No. bank accounts in NL		1.6	1.7	1.5	1.9	1.8	1.4	1.4
Bank account abroad?		0.06	0.01	0.07	0.11	0.01	0.11	0.04
No. respondents		2,258	620	1,638	123	272	724	519
Fraction of total:								
In sample			0.27	0.73	0.05	0.12	0.32	0.23
In population			0.80	0.20	0.04	0.05	0.06	0.05

Note: This table summarises the various control variables for the respondents to the survey. Column 1 gives data for the Dutch population in 2007 aged over 15 provided by Statistics Netherlands. Numbers represent fractions, with the exception of age and the number of bank accounts, which are shown in averages, urban, which shows the average urbanisation score on a scale from 1 (very low) to 5 (very high), and the number of respondents, which is shown in totals. The data are un-weighted.

age, education, degree of urbanisation, region where the individual lived, and their ethnic background, which we will use for the analyses in Section 3.4. Second, Table 3.3 shows that nearly all respondents, irrespective of their background, have a Dutch bank account. This may be explained by the fact that in the Netherlands every person aged 18 years and older having a permanent home address or being registered with a recognised aid or governmental organisation is entitled to open a bank account. Hence, any potential difference in payment behaviour will have to be explained by other factors than particular population groups not having access to a bank account or debit card.

Table 3.4 presents the daily number of payments recorded per person across the various population groups. Given the limited use of credit cards and the e-purse, we focus on cash and debit card payments only. For the full sample, on average, the respondents recorded 1.6 cash payments and 0.7 debit card payments per person per day. The ratio of cash payments versus the total number of POS payments is fairly equal across the various groups, with one clear exception. Whereas, on average, all respondents reported a cash share of around 69%, the first-generation non-western respondents indicated to have paid around 74% of all their POS payments in cash. This may indicate that payment choices indeed differ for particular population groups, which we will further assess in Section 3.4.

3.3.3 Empirical model and estimation method

In order to formally analyse the role of consumers' background, we use econometric estimation techniques to model the choice of our respondents between cash and debit card. The dependent variable is a dummy variable equal to one in case the respondents used cash for a particular transaction and zero otherwise ($Cash$). Given the binary nature of the dependent variable, we use Probit regression techniques.[5] In total, we analyse 4,225

[5]See, for example, Verbeek (2000). Probit models assume a standard normal distribution. Alternatively, Logit models can be used assuming a logistic distribution. As the two distributions are very similar, Probit and Logit models typically yield very similar

Table 3.4: Payment characteristics of survey participants

	(1) Full sample	(2) Background Dutch	(3) Foreign	(4)	(5)	(6)	(7)
			All	Western		Non-western	
				1st gen.	2nd gen.	1st gen.	2nd gen.
No. cash payments	1.61	1.50	1.66	1.70	1.45	1.80	1.56
No. debit card payments	0.73	0.74	0.73	0.86	0.75	0.64	0.80
Ratio cash/total payments	0.69	0.67	0.69	0.66	0.66	0.74	0.66
Cash at start (EUR)	26.40	28.00	25.50	35.40	30.30	30.50	20.00

Note: This table presents the number of cash and debit card payments recorded per person per day for various backgrounds. Cash at start refers to the amount of cash people carried at the beginning of their survey day. Numbers are un-weighted averages.

transactions. Since the analysis is at the transaction- rather than at the consumer-level, we cluster the standard errors by respondent to account for potential correlation across different transactions made by the same person.

The empirical analysis is split up in two steps. First, we run a benchmark regression without variables on foreign backgrounds. We run this regression using a rich set of covariates, consisting of consumer, transaction and location characteristics as suggested by the literature.[6] With respect to the consumer characteristics, we use dummy variables for the person's gender (Sex), age category (Age), education category (Edu), income category (Inc), marital status ($Part$), household size ($Size$), homeownership ($Home$) and region of residence in the Netherlands (Reg). Also, the model includes the number of bank accounts abroad ($Bank$) and the amount of cash in pocket at the start of the survey day ($Money$). The transaction characteristics include the transaction amount ($Amount$) and a dummy for the day of the week (Day), with Sunday being the reference day. In addition, we use dummies for the various pre-defined locations where the transaction occurred (Loc). The supermarket, which accounted for 28% of all transactions, is used as the benchmark location. As a final control, we include the type of survey instrument used, i.e. internet, face-to-face or paper-based ($Survey$). Consequently, the benchmark model can be summarised as follows:

results. Additional analyses indeed demonstrated that the signs of the coefficients are identical across the two different specifications. Moreover, the statistical significance of the explanatory variables turned out to be virtually identical.

[6] As described in Section 1.3, payment instrument characteristics and in particular financial incentives, may play a role as well. Although Dutch consumers are not faced with explicit bank-imposed transaction fees or incentive and reward programs, POS transactions may carry some retailer-imposed costs, as retailers in the Netherlands are allowed to apply a surcharge for specific payment instruments. Bolt et al. (2010) found that 22% of Dutch retailers applied a surcharge for small debit card payments in 2006. Since then, however, the relative safety and efficiency advantage of debit cards have led to a strong decline in the use of surcharges. At the time of our survey, in 2009, it is estimated that only 5% of the debit card accepting retailers was applying a surcharge (HBD (2011)). Still, it would have been useful to use a dummy variable to control for potential surcharge effects. Unfortunately, due to unavailability of data, we were not able to do so.

$$Cash = Cash(Sex, Age, Edu, Inc, Part, Size, Home, Reg, Bank, Money, Amount, Loc, Day, Survey) \quad (3.1)$$

In the next step, we extend the benchmark model as summarised in Equation 3.1 with variables measuring foreign background. We do this in two parts. First, we add dummy variables following the official classifications of Statistics Netherlands as summarised in Table 3.2. So, we use dummies indicating whether an individual has a foreign background ($Foreign$), from which region he or she stems, i.e. a western ($West$) or non-western country ($NWest$), and whether he or she is a first ($First$) or second-generation ($Second$) migrant. Second, we further refine the analysis by using dummies defined on a person's country of origin ($Country$).

3.4 Results

3.4.1 Cash versus cards

Table 3.5 shows the parameter estimates and standard errors (in italics) of a selection of covariates of the benchmark model analysing consumers' choice between cash and cards. Whereas the estimated coefficients of a Probit model have no direct interpretation, their signs and significance have. Regarding the consumer characteristics, there are a number of intuitive results. Note that the results should be interpreted relative to the reference category, i.e. a debit card payment made in a supermarket on a Sunday by a Dutch single male, aged between 35 and 44, living in the Western part of the Netherlands, whose highest educational qualification is primary school. In accordance with the literature (see Section 1.3), we find that age and education play a significant role, with younger and more educated consumers being more likely to pay electronically. However, we find no differences between males and females. The negative parameter suggests that

Table 3.5: Using cash over cards: the role of consumer, transaction and location characteristics

Consumer characteristics		Transaction and location characteristics	
Female	−0.07	Amount	−0.01***
	0.11		*0.00*
Age:		Location:	
15-24	−0.03	Street vendor	1.46***
	0.16		*0.24*
25-34	0.01	Food (small shop)	0.67***
	0.15		*0.15*
45-54	0.13	Fashion/shoes	−0.89***
	0.15		*0.27*
55-64	0.35**	Restaurant/bar	0.76***
	0.16		*0.14*
65 and older	0.16	Gas station	−0.69***
	0.16		*0.15*
Education:		Day of the week:	
Secondary	−0.28*	Wednesday	−0.43**
	0.15		*0.19*
Bachelor	−0.66***		
	0.21	Constant	0.62
Master	−0.49**		*0.55*
	0.23		
Partner	−0.21*		
	0.12		
Cash at start of day	0.00**		
	0.00		
No. Observations			4,225
Wald chi2(50)			341.68
Prob. > chi2			0.0000
Pseudo R2			0.2194

Note: Parameter estimates and standard errors (in italics) for a Probit regression, where the dependent variable is a dummy equal to 1 in case of cash payments and 0 in case of debit card payments. The model includes a full set of variables as described in Section 3.3.3. The table shows results for selected covariates. The reference category is a debit card payment made in a supermarket on a Sunday by a Dutch single male, aged between 35 and 44, living in the Western part of the Netherlands, whose highest educational qualification is primary school. Observations are weighted on the basis of gender, age, education, ethnic background, degree of urbanisation and region. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

females are less likely to use cash, but the effect is not significantly different from zero. Our results further show that consumers having a partner are less likely to use cash. One explanation could be a wealth effect, which would be in line with earlier findings of higher income people being more prone to use electronic payment instruments (see Section 1.3 and references therein). Moreover, the amount of cash that people carry with them has a significant positive relation to cash usage during the day. Regarding the transaction characteristics, the findings are in line with the literature too. Higher transaction values are less likely to be paid in cash. In terms of location, cash is more often used at street vendors, at small food stores and in restaurants and bars. Purchases made at fashion and shoe stores and at gas stations, by contrast, are more often paid by debit card. Since we have already controlled for differences in transaction amounts explicitly, these findings most probably reflect differences in debit card acceptance across the various types of stores.[7] Finally, there is an indication that on Wednesday consumers are more likely to use their cards in stead of cash than on Sunday.[8]

Turning to the role of foreign backgrounds, Table 3.6 presents the results of the Probit regressions using information on a person's region of origin and generation. As, apart from their signs, the coefficients of Probit models are not easy to interpret, Table 3.6 presents their marginal effects, i.e. the changes in the predicted probability that a transaction is paid in cash for a change in each of the explanatory dummies from 0 to 1 leaving all other variables unchanged. These marginal effects should be interpreted relative to the reference category, i.e. a person having a Dutch background.

[7] About 90% of all Dutch retail traders accept debit card payments. The availability of payment terminals, however, considerably differs across stores: supermarkets (100%), gas stations (100%), fashion stores (97%), specialised food stores (82%), catering (64%) and street vendors (28%) (HBD (2011)).

[8] Although this effect is significant, it is not immediately clear what drives this finding. It could potentially be related to a difference in type of activities undertaken or type of purchases made. The fact that many primary schools in the Netherlands are closed on Wednesday afternoon could play a role here. Hence, future research would be valuable to further explore this issue.

First of all, we find no overall difference between individuals with a Dutch and a foreign background. Someone with a foreign background is around 1.8 percentage points (pp.) more likely to use cash, but the effect is not significantly different from zero (Column 1). When we split the data based

Table 3.6: Using cash over cards: the role of region of origin and generation

	(1)	(2)	(3)	(4)
Foreign background	0.018			
	0.023			
1st generation		0.029		
		0.029		
2nd generation		0.001		
		0.024		
Western			0.005	
			0.028	
Non-western			0.038	
			0.029	
1st gen. western				−0.003
				0.042
1st gen. non-western				0.060*
				0.031
2nd gen. western				0.012
				0.029
2nd gen. non-western				−0.007
				0.035
No. Observations	4,225	4,214	4,225	4,214
Wald chi2	341.79	341.13	342.18	347.42
Prob. > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.2195	0.2199	0.2197	0.2205

Note: Marginal effects and standard errors (in italics) based on Probit regressions. The dependent variable is a dummy equal to 1 in case of cash payments and 0 in case of debit card payments. The marginal effects should be interpreted relative to a person having a Dutch background. The regressions include a full set of control variables as described in Section 3.3.3. Observations are weighted on the basis of gender, age, education, ethnic background, degree of urbanisation and region. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

on generation, again we find no significant differences, although there is a hint of certain generational differences (Column 2). For second-generation migrants, the marginal effect is essentially zero, whereas for first generations, the probability of using cash is around 3 pp. higher than for native Dutch individuals. When taking the region of origin into account (Column 3), there is an indication that persons with non-western backgrounds are more likely to use cash. Again, though, the differences are not significant. However, when we combine the information on region and generation (Column 4), we do find a significant difference between foreign and domestic backgrounds. For first-generation migrants of non-western origin, the probability of using cash is 6 pp. higher compared to persons with a Dutch background. For second-generation non-westerners, the chances of using cash are 0.7 pp. smaller, although not significantly different. For those from western countries, there are no significant differences.

Overall, the results in Table 3.6 suggest that region of origin and generation are relevant factors in consumers' behaviour. Table 3.7 further expands the analysis by using information on a person's country of origin (Column 1) and a further breakdown by generation (Column 2). We still aggregate Eastern European and other European countries, as we have a limited number of observations for the individual countries in these groups. Again, for ease of interpretation, Table 3.7 presents marginal effects. The results show that participants with a German background are around 9.3 pp. more likely to pay in cash than the native Dutch, while persons of Turkish and Moroccan origin are around 7.5 pp. more probable to pay cash. However, once again, differences between generations are present (Column 2). The higher cash usage among German, Turkish and Moroccan migrants is only restricted to the first generation. In fact, for second-generation persons with a Turkish or Moroccan background, the differences compared to native Dutch consumers are negligible. For individuals of German origin, the difference is around 6 pp., but not significant.

Table 3.7: Using cash over cards: the role of country of origin

Country	(1)	(2)	Country (Cont.)	(1) (Cont.)	(2) (Cont.)
Germany	0.093**		Suriname	0.024	
	0.038			*0.034*	
1st gen.		0.129**	1st gen.		0.041
		0.057			*0.043*
2nd gen.		0.063	2nd gen.		−0.008
		0.046			*0.043*
Eastern Europe	0.023		Antilles, Aruba	−0.012	
	0.051			*0.041*	
1st gen.		0.003	1st gen.		0.020
		0.071			*0.053*
2nd gen.		0.057	2nd gen.		−0.078
		0.063			*0.051*
Europe (other)	−0.054		Turkey	0.075*	
	0.048			*0.039*	
1st gen.		−0.114	1st gen.		0.089**
		0.092			*0.041*
2nd gen.		−0.020	2nd gen.		0.023
		0.048			*0.053*
Indonesia	−0.033		Morocco	0.074*	
	0.044			*0.044*	
1st gen.		−0.020	1st gen.		0.088*
		0.078			*0.050*
2nd gen.		−0.045	2nd gen.		0.033
		0.046			*0.057*
No. Observations				4,215	4,204
Wald chi2				350.45	359.39
Prob. > chi2				0.0000	0.0000
Pseudo R2				0.2219	0.2230

Note: Marginal effects and standard errors (in italics) based on Probit regressions. The dependent variable is a dummy equal to 1 in case of cash payments and 0 in case of debit card payments. The marginal effects should be interpreted relative to a person having a Dutch background. The regressions include a full set of control variables as described in Section 3.3.3. Observations are weighted on the basis of gender, age, education, ethnic background, degree of urbanisation and region. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

To summarise, we find indications that first-generation migrants from three countries that can be seen as cash-oriented (see Figure 3.1) continue to have strong preferences for cash after migration to the Netherlands. This suggests that migrants bring along their home-country payment habits when migrating, without passing it on to the second generation. This is in line with the related literature on home-country habits and cultural assimilation as discussed in Section 3.2.2. However, for another cash-oriented economy, Indonesia, we find no significant differences with the native Dutch population in terms of cash use. Therefore, in the next section, we will further explore the role of home-country cash orientation using data on national payment habits supplied by the World Bank (2008).

3.4.2 Additional analyses

In this section, we present three additional analyses to further assess the role of consumers' background in their choice between cash and debit card at the POS. First, we run two additional Probit regressions focussing exclusively on payments made in supermarkets and at gas stations. This serves as an additional check whether the observed differences in payment choices are indeed related to the characteristics of the consumer instead of to any supply-related factors, such as the (un)availability of POS terminals or transaction surcharges applied at the particular POS locations that the different population groups visit. That is, virtually all supermarkets and gas stations accept both cash and card payments, which means that consumers always have a choice here. Moreover, in both sectors the usage of transaction surcharges is negligible (HBD (2011)). The marginal effects of the two Probit regressions are shown in Table 3.8. We find no differences between persons with a Dutch and a foreign background when it comes to paying in supermarkets (Column 1). Neither the region of origin nor the generation are relevant factors for payment choices made for supermarket purchases. First-generation non-westerners are 4.7 pp. more likely to pay in cash, but the differences are not significant. Turning to payments at

gas stations (Column 2), however, we do find a significant difference. The probability of using cash among first-generation non-westerners is 13 pp. higher than that of individuals with a Dutch background. For the other groups as well, the likelihood of using cash is higher, although not significantly different. These results confirm our earlier findings, that differences in payment choices are only present for first-generation non-westerners. As the analysis exclusively focussed on payments made at gas stations (i.e. all of which accept debit cards and none of which apply surcharges), these differences in behaviour can not be attributed to the (un)availability of POS

Table 3.8: Using cash over cards: focus on supermarkets and gas stations

	(1) Supermarket	(2) Gas station
1st generation:		
Western	−0.010	0.160
	0.070	*0.107*
Non-western	0.047	0.132**
	0.052	*0.061*
2nd generation:		
Western	0.009	0.075
	0.052	*0.068*
Non-western	−0.050	0.048
	0.060	*0.075*
No. Observations	1,208	273
Wald chi2	143.59	704.23
Prob. > chi2	0.0000	0.0000
Pseudo R2	0.2572	0.5698

Note: Marginal effects and standard errors (in italics) based on Probit regressions. The dependent variable is a dummy equal to 1 in case of cash payments and 0 in case of debit card payments. The marginal effects should be interpreted relative to a person having a Dutch background. The regressions include a full set of control variables as described in Section 3.3.3. Observations are weighted on the basis of gender, age, education, ethnic background, degree of urbanisation and region. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

terminals or to the use of surcharges. Therefore, the behavioural differences are most likely to be consumer-related. The reason why we only find different payment patterns in gas stations and not in supermarkets may be attributed to the fact that they are two different sectors in terms of payments. Overall, 60% of all supermarket transactions and 37% of total supermarket sales are paid by cash, whereas in gas stations the share of cash is significantly lower, i.e. 44% of all transactions and 18% of total sales (Jonker et al. (2012)). So, as cash usage in supermarkets is relatively high among all population groups, the stronger preference for cash among first-generation non-westerners appears less clearly. By contrast, due to the relatively high share of card payments in gas stations, the strong cash preference among this latter group is clearly emphasised.[9]

Second, there may be an endogeneity issue regarding the explanatory variable 'cash at start of the day'. Although we assume this variable to be exogenous and determined outside the model, consumers having a higher preference for cash may be expected to carry larger amounts of cash. To explore this possible endogeneity, we re-ran the regressions in Tables 3.5 - 3.7 without including this variable. Overall, there were no substantial changes to our conclusions on the role of foreign backgrounds. Both marginal effects and standard errors were broadly similar. We therefore conclude that the biases due to the possibly endogenous nature of this variable are limited.

Third, we employ the World Bank (2008) data as described in Section 3.2.1 to study more directly the role of cash orientation in the home country. Due to the lack of information about cash usage, we use the data on the number of card transactions made per capita in the different countries represented in our sample to distinguish between cash and non-cash oriented countries. One caveat to the analysis is the missing data for Suriname, the Netherlands Antilles and Aruba, due to which we lose around

[9]It would be interesting to further explore the diverging payment preferences of first-generation migrants from non-western countries, for example, by using interaction terms. This would allow for a deeper understanding of whether the effects differ, for example, by the person's age, the urbanisation degree of the region of origin, or by type of purchase made. Unfortunately, our dataset did not allow for such detailed analyses.

250 observations.[10] Another limitation is the fact that for some countries in our sample either the number of debit card or the number of credit card transactions is missing. Therefore, we run three separate Probit regressions extending the benchmark model as summarised in Equation 3.1 with either the number of debit card transactions ($DCtrx$), the number of credit card transactions ($CCtrx$), or the sum of both ($TOTtrx$). In each case, we use data from the 2006 vintage of the World Bank data, as the number of missing observations is smallest for that year. The results are presented in Table 3.9. For each of the three regressions, we find a negative relationship

[10]Given the great diversity of other countries included in the dataset and the large number of total observations, we do not expect this data unavailability to have affected the overall results.

Table 3.9: Using cash over cards: the role of card use in the home country

	(1) Debit card	(2) Credit card	(3) Total card
Marginal effect	-0.0017^{**}	-0.0056^{***}	-0.0025^{***}
	0.0008	*0.0015*	*0.0007*
No. Observations	2,040	1,215	1,215
Wald chi2	208.86	283.22	276.23
Prob. > chi2	0.0000	0.0000	0.0000
Pseudo R2	0.2527	0.3477	0.3534

Note: Marginal effects and standard errors (in italics) based on three Probit regressions. In each case, the dependent variable is a dummy equal to 1 in case of cash payments and 0 in case of debit card payments. The right-hand side variables are the number of debit card (Column 1), the number of credit card (Column 2) or the total number of card payments (Column 3) per capita in the country of origin in 2006 as reported in World Bank (2008). In addition, the regressions include the full set of control variables as described in Section 3.3.3. The marginal effects should be interpreted relative to a person having a Dutch background. Observations are weighted on the basis of gender, age, education, ethnic background, degree of urbanisation and region. Standard errors are clustered by respondent. ***/**/* denotes significance at the 1%/5%/10% level respectively.

between card use in the home country and the likelihood of using cash in the Netherlands. So, a more intensive use of cards in countries of origin is associated with a lower likelihood of using cash in the Netherlands. This finding supports the earlier results in Tables 3.6 - 3.8 that payment habits related to foreign backgrounds continue to influence the choice between payment instruments after migration.

3.5 Conclusions

In this chapter, we examined a detailed set of transaction and consumer data that was collected through a one-day payment diary among both individuals with a Dutch and a foreign background. Overall, we find a number of results suggesting that foreign backgrounds are relevant in consumers' payment choices after migration. First, we find that first-generation migrants from non-western countries are more likely to use cash than consumers having a Dutch background. Second, we find that persons born in three countries that, compared to the Netherlands, can be classified as cash-oriented, are more likely to pay by cash after migration as well. Third, we find evidence that the number of card transactions per capita in a person's country of origin is negatively related to their likelihood of using cash in the Netherlands. These findings are robust to controlling for a wide range of consumer, transaction and location characteristics, and suggest that payment habits acquired abroad continue to influence payment behaviour after migration. Herewith our findings correspond to the related literature in other research fields, which also demonstrates the importance of home-country culture. Also, our findings confirm earlier findings of convergence of the second generation towards the culture in the host country. That is, for second-generation migrants, we find no evidence of different payment habits compared to individuals with a Dutch background.

The results offer valuable policy implications related to the question whether and how the use of electronic payment instruments can be fur-

ther increased. First, the results point to relatively high levels of cash usage among particular population groups. This suggests that there is still room for further digitisation. However, this strong cash preference is only present for first-generation migrants originating from cash-oriented economies. Therefore, the possibilities to stimulate electronic ways of paying strongly depend on the size of this particular group. Second, the finding that differences in payment preferences are no longer present for the second generation suggests that the diverging payment habits among the first generation are not caused by generic migrant-related barriers or passed on between generations. Instead, it shows that they are mainly driven by home-country habits, i.e. habits formed in the country where a person has grown up. This suggests a potential case for targeted information campaigns that aim at changing these habits, so to further stimulate the use of electronic payment instruments.

Chapter 4

The safety of paying: Consumer perceptions and payment choices[1]

How do consumers assess the safety of point-of-sale payment instruments and how does this affect their payment choices? We investigate this question by distinguishing between consumers' views on the probability of losses when carrying or using a given instrument and their perceptions of the severity given these losses. We use 2008 consumer survey data to test this framework and demonstrate that the degree to which consumers assess a payment instrument as safe is determined mainly by their perception of the probability that incidents may occur when using or carrying it. They do consider the severity of potential incidents as well, though to a much lesser degree. Second, we find that beliefs about the probability and severity of potential payment incidents vary with consumers' personal characteristics and past experiences. Finally, we show that the use of cash and debit cards is significantly influenced by consumers' perceptions of safety.

[1] An earlier version of this work has been published as Kosse, A. (2013b), The safety of cash and debit cards: A study on the perception and behavior of Dutch consumers, *International Journal of Central Banking* 9(4): 77-98.

'Out of this nettle - danger - we pluck this flower - safety'
William Shakespeare (1564 - 1616)

4.1 Introduction

As demonstrated in Chapter 1, the use of payment instruments has strongly changed over the past decades. Especially, there has been a global trend towards electronic payment instruments. This has not only created opportunities in terms of social cost savings and improved user satisfaction, but also introduced new types of safety risks. In particular, the strong increase in the acceptance and usage of payment cards have made them progressively susceptible for new forms of fraud. One of the main types of card fraud that countries have been facing is skimming fraud, where the card data on the magnetic stripe are copied and the Personal Idendification Number (PIN) is captured to produce counterfeit cards. In the Netherlands, for instance, total skimming fraud has increased from less than EUR 4 million in 2005 to EUR 29 million in 2012.[2] Although the fraud losses are still relatively small compared to the overall size of the cards market, the impact on society as a whole could be much larger. Due to personal experiences and increasing media attention, consumers may lose their confidence in paying electronically and shift to alternative ways of paying. As electronic payment instruments are still generally found to be less costly to society than their paper-based counterparts (see Section 1.2.5), this could eventually harm the overall cost efficiency of the payment system.

In light of this, it is important to understand how consumers assess the safety of payment instruments and how this affects their payment choices. Despite the vast amount of payments literature as summarised in Chapter 1, research into the impact of perceived or actual safety on consumers' choice between payment instruments is scarce and does not provide a unanimous answer. Several papers suggest that safety is one of the factors considered

[2]Information provided by the Dutch Banking Association.

when choosing how to pay (e.g. Alvarez and Lippi (2009), Arango and Taylor (2009), Kahn and Liñares Zegarra (2012)). Others, however, find no evidence of safety playing an important role (e.g. Yin and DeVaney (2001), Ching and Hayashi (2010), Schuh and Stavins (2010)). Therefore, the aim of this chapter is to investigate the impact of perceived safety on the use of cash and debit cards. However, before doing so, we first take one step back and examine the determinants of consumers' safety perception. We use 2008 survey data collected among Dutch consumers to assess how their views on the safety of point-of-sale (POS) payment instruments are influenced by perceptions of probabilities of incidents occurring when carrying or using the instruments and by perceptions of the severity of these incidents. Although this approach of separating between perceived probabilities and perceived consequences is commonly used in other research fields (e.g. BIS (2005), Rundmo (1997), Yeung and Morris (2001)), it has not been considered in retail payments research before. Therefore, by studying the entire process from safety perception to payment behaviour, this chapter provides new insights into whether safety is a factor that may hinder a further growth in the use of electronic payment instruments. In addition, it allows for a better understanding of how to preserve consumers' confidence in the safety of paying and of how to further stimulate electronic ways of paying.

This chapter proceeds as follows. Section 4.2 presents background information about payments fraud and safety risks and summarises the related literature and the main research questions. Section 4.3 describes the methodology and data used, whereas Section 4.4 reports the results. Section 4.5 summarises and concludes.

4.2 Background and research questions

4.2.1 Payments fraud and safety risks

Overall, the global trend towards electronic retail payment instruments as discussed in Chapter 1 has among other things been driven by a need of enabling payers and payees to make and to receive payments in a faster, more convenient and less costly way (CPSS (2012)). However, the global trend towards digitisation has also brought in new types of safety risks. In particular, due to the strong growth in payment card acceptance and usage, card fraud has become a serious threat. Global card fraud statistics are not available, but Europol reports estimates of around EUR 1,500 million for the European Union in 2011 (Europol (2012)). There are various forms of card fraud, such as fraud with lost and stolen cards, and so-called card-not-present fraud, which relates to the misuse of card data for payments where the card is not physically handed over and inspected, such as for payments via the internet or payments by phone.[3] One of the most important types of card fraud that countries have been facing over the past 10 years, however, is skimming fraud, where both the data on the magnetic stripe are copied and the PIN is captured. The data and the PIN are subsequently used to produce counterfeit cards in order to illicitely pay and withdraw money from the cardholder's account.

In the Netherlands, total debit card skimming fraud has increased materially over the past decade, from less than EUR 4 million in 2005 to EUR 29 million in 2012, reaching its peak of EUR 39 million in 2011.[4] Initially, the cards were mainly copied at Automated Teller Machines (ATMs), but since 2008 the fraud has spread towards payment terminals in shops, at petrol stations and ticket machines as well. Dutch banks compensate for the damages incurred when the afflicted cardholders have taken reasonable

[3] In many card-not-present fraud cases, the rightful owners maintain possession of the card and are unaware of the unauthorised use until they review their card statements or they are notified by the bank or merchant.

[4] Information provided by the Dutch Banking Association.

safety measures. However, the total costs to the victims are higher than solely the financial losses. In order to limit the financial damages as much as possible, banks immediately block the underlying accounts as soon as the fraud has been discovered, leading to administrative and temporary payment inconveniences as well. In fact, this not only holds for the victims. By way of precaution, banks also block the accounts of other cardholders whose card may potentially have been copied. Moreover, at a regional level, all cardholders as well as retailers may be confronted with the inconvenience of temporary closedowns of stricken ATMs and payment terminals.

The scale of skimming fraud is still relatively small compared to the size of the Dutch debit cards market. In 2009, around 0.3% of all debit cards were copied, 0.4% of all ATMs and payment terminals were sabotaged and total financial damages amounted up to 0.03% of the total debit card turnover at the POS.[5] Yet, all stakeholders along the payments chain give high priority to its prevention and fight so as to preserve public confidence in the debit card. Banks and retailers try to minimise the risks and consequences through continued investment in anti-skimming devices and fraud detection systems and through informing and educating the public by means of public awareness campaigns. In particular, the shift towards the EMV technology is expected to reduce the skimming threat. The EMV technology is an international standard for debit and credit card transactions at ATMs and payment terminals.[6] The two main characteristics of the standard are that transactions are authorised by means of a PIN instead of a signature and that the data are no longer stored on a magnetic stripe but on a chip embedded in the card. As the chip is more secure than the magnetic stripe, the EMV technology is considered as an important measure in fighting the skimming threat. As from January 2012, all card transactions in the Netherlands have been conducted via the EMV technol-

[5]Calculations based on payment statistics of De Nederlandsche Bank and Currence as published on www.dnb.nl and www.currence.nl.

[6]The name EMV comes from the initial letters of Europay, Mastercard and Visa, which originally developed the standard.

ogy and the first results are already visible in that attempted withdrawals with skimmed magnetic stripes are no longer successful in the Netherlands or in other countries that have adopted EMV (Currence (2011)).

Apart from payment card fraud, consumers may also sustain fraud losses when using other payment instruments for their POS purchases. Due to their narrow use and acceptance, fraud with electronic money solutions is still limited. By contrast, as the vast majority of payments is still made in cash (see Chapter 1), banknotes are everlastingly attractive for counterfeiting. In the Netherlands, 29,700 euro counterfeits were intercepted in 2011, having a total 'value' of EUR 1.5 million. Compared to total skimming fraud losses this is still relatively small. Also, the likelihood of encountering a counterfeit banknote is still limited. Of all banknotes tested by the Dutch banking sector, around 1 out of 60,000 (i.e. 0.0015%) appeared to be fake, and in terms of value, total counterfeit losses amounted up to 0.003% of the total POS cash turnover.[7]

The risk of skimming fraud and receiving counterfeits typically arises from *using* the particular payment instruments for paying or withdrawing money. However, consumers also run various safety risks when *carrying* payment instruments, such as the risk of loss, pickpockets or violent robbery. In case of cash, these incidents will result in an immediate loss of the money carried. The same holds for electronic money stored on a chip embedded in a card if the chip can be used without entering a PIN. By contrast, theft or loss of payment cards may only lead to financial losses if the PIN, if any, is captured and if the cardholder is unable to block the underlying bank account in time. In case of a violent robbery, the losses to the consumer will even be larger when also taking into account the physical and emotional damages. Estimates show that in 2008 around 1 out of 200 Dutch inhabitants fell victim to pickpockets and that about 1 out of 700 inhabitants were robbed.[8]

[7]Estimates based on information provided by De Nederlandsche Bank.

[8]Estimates based on information provided by Statistics Netherlands and AD Crime Indicator *(AD Misdaadmeter)* as published on www.cbs.nl and www.ad.nl/misdaadmeter.

4.2.2 Related literature

As summarised in Chapter 1, the literature examining consumers' choices between payment instruments departs from the idea that payment instruments differ from each other on various attributes, such as speed, ease of use and anonymity, and that consumers' choice of which instrument to use is based on their preferences and net benefits derived from it. There are a few theoretical papers that explicitly account for safety and security when modelling payment choices. When studying consumer demand for cash, for instance, Alvarez and Lippi (2009) incorporate the probability of cash theft into their model and assume that consumers keep smaller cash balances and increase the number of cash withdrawals when the likelihood of theft increases. Bolt and Chakravorti (2008a), He et al. (2008) and Kahn and Roberds (2009) too consider the probability of getting mugged as a proxy for the safety benefit of cards over cash. All these papers, however, assume cash to be inferior to the alternative means of payment as far as safety is concerned, without taking into account that cards and other non-cash instruments may entail safety and fraud risks too.

Also in the empirical payments literature, the effects of safety and fraud are still underexposed. There are a number of studies that empirically assess consumers' attitudes towards risks and the impact of perceived or actual safety on the choice between payment instruments. Yet, they do not provide a unanimous conclusion. Some papers find that safety is one of the factors considered when choosing how to pay (e.g. Jonker (2007), Borzekowski et al. (2008)) and that perceptions of risks negatively affect the usage of payment instruments (e.g. Arango and Taylor (2009), Kahn and Liñares Zegarra (2012)). For instance, Humphrey et al. (1996) show that higher rates of violent crime are associated with a lower reliance on cash and debit cards and with a corresponding increase in the use of all other payment instruments. Similarly, Cheney (2006) expresses real concern for a potential erosion of consumer confidence in paying electronically due to safety incidents related to the use of non-cash payment instruments. By

contrast, Yin and DeVaney (2001), Ching and Hayashi (2010) and Schuh and Stavins (2010) find no evidence of safety playing an important role in consumers' payment choice.

Consumers' assessment of safety and its impact on behaviour has been studied more extensively in other research fields. A commonly adopted approach is that of separating the probability of losses (PL) and the severity given losses (SGL). This approach departs from the idea that consumers' safety perception is influenced by both their perception of the probability of incidents occurring and their perception of the severity of these incidents. In economics and finance, for instance, the probability of default (PD) and the loss given default (LGD) are often used when modelling credit risks (e.g. BIS (2005)). Also in food, health, environmental and marketing sciences, this two-step approach is found to be useful when modelling risk perception and behaviour (e.g. Royal Society (1992), UK Department of the Environment (1995), Rundmo (1997), Yeung and Morris (2001)).

There is evidence that consumers' views on probabilities and consequences vary with personal characteristics. Sapp (2003) and Wildavsky and Dake (1990), for instance, find a strong effect of gender when examining food technology adoption and risk perception. They show that men perceive risks as lower and have a higher sense of trust compared to women. Regarding the impact of safety on behaviour and choices, there is general consensus in the non-payments-related literature that perceptions of risks negatively influence behaviour, with consumers taking various actions to reduce risks. For example, Huang (1993), Eom (1994), Weinstein (1993) and Yeung and Morris (2001) show that the higher the perceived probability and the higher the perceived impact of possible incidents, the more consumers seek risk relief.

4.2.3 Research questions

Given the background provided above, the main objective of this chapter is to investigate the role of perceived payments safety in consumers' choice

between POS payment instruments. To this end, this chapter first examines the determinants of consumers' views on the safety of payment instruments. Following the approach of separating the probability of losses and the severity given losses, the first research question reads as follows: *"To what extent are consumers' views on the safety of POS payment instruments influenced by their perceptions of probabilities of incidents occurring when carrying or using the instruments and by their perceptions of the severity of these incidents?"*. Second, we examine the role of perceived safety in consumers' daily payment choices by providing an answer to the question: *"To what extent is the use of cash and debit cards influenced by their level of safety as perceived by the consumer?"*.

Following the related literature on risks and behaviour, we may expect that consumers' views on the safety of payment instruments are influenced both by their perceptions of probabilities and their perceptions of consequences. Similarly, we may expect that these perceptions differ across consumers, depending on their personal characteristics and experiences. Finally, following the general consensus from the literature, we may expect to find that the use of cash and debit cards is negatively influenced by their perceived levels of safety.

4.3 Methodology and data

4.3.1 Survey design and data collection

In order to examine the determinants of consumers' views on the safety of payment instruments and the impact of perceived safety on consumers' payment choices, we conducted an extensive payment survey among more than 2,000 Dutch consumers aged 15 years and over. The objective of the survey was to collect detailed information about consumers' personal characteristics, as well as about their subjective judgements on the safety of various POS payment instruments. Also, the survey aimed to provide a general picture of consumers' POS payment preferences. Given the length and level

of detail of the survey, we did not ask respondents to, additionally, register their individual payments in a payment diary as suggested in Chapter 2, as this would place a considerable additional burden on the respondents, thereby potentially harming the validity of the results. Moreover, we were merely interested in consumers' general payment habits instead of in their individual payment choices made.

The fieldwork was conducted in the third week of April 2008. The respondents were selected from the CentERpanel. This is an internet panel reflecting the composition of the Dutch-speaking population. The panel is managed by the Dutch research institute CentERdata, which is closely affiliated to Tilburg University. Although respondents participated online by answering an electronic questionnaire, potential biases caused by not having access to the internet are limited, as participants without internet access are provided with special equipment allowing them to access the internet through their TV. The questionnaire was answered in full by 1,672 individuals, corresponding to a 65% response rate. This sample size is large enough for drawing valid conclusions regarding the true general payment habits and judgements of the Dutch population, based on a 95% confidence level and a 5% confidence interval.

For the purpose of this study, we combine the data collected in this payment survey with additional data collected in the DNB Household Survey (DHS). The DHS is a yearly questionnaire commissioned by De Nederlandsche Bank and distributed by CentERdata among the same group of households for the collection of information on assets, liabilities, work, housing, mortgages, health and income, and various subjective measures, such as expectations, as well as investment and savings motives. For more information about the CentERpanel and the DHS, see Teppa and Vis (2012).

Table 4.1 summarises the main personal characteristics of the respondents. Overall, the final sample is characterised by a slight overrepresentation of men, the elderly and higher-educated people. Therefore, we constructed sampling weights based on age, gender and education, which we

Table 4.1: Characteristics of survey participants

	Sample	Population
Gender:		
Men	55%	49%
Women	45%	51%
Age:		
15 - 24	5%	15%
25 - 34	12%	15%
35 - 44	16%	18%
45 - 54	22%	18%
55 - 64	23%	16%
Over 65	23%	19%
Education:		
Primary	6%	9%
Lower secondary	27%	24%
Higher secondary	12%	10%
Intermediate vocational	20%	31%
Higher vocational	24%	16%
University	12%	9%

Note: This table summarises the main sample characteristics, as well as data for the Dutch population aged over 15 in 2008 supplied by Statistics Netherlands.

will use in the remainder of this chapter so as to ensure representativeness for the Dutch population aged 15 years and more.

4.3.2 Key statistics

Table 4.2 presents an overview of the respondents' general POS payment habits. For each payment instrument, the respondents were asked to indicate how often they generally use it for payment of POS purchases. The results confirm that cash and debit cards are the most important payment instruments used at the POS in the Netherlands. The majority of the respondents indicated to pay with both cash and a debit card at least once a week. The e-purse product Chipknip, as well as credit cards are significantly less often used.

Table 4.2: Frequency of use of POS payment instruments

	Cash	Debit card	E-purse	Credit card
Every day	14%	10%	4%	0%
A few times a week	48%	54%	10%	2%
Once a week	20%	15%	7%	2%
A few times a month	11%	10%	14%	9%
Once a month	3%	4%	8%	9%
Less than once a month	3%	4%	24%	45%
Never	1%	3%	34%	32%
No. respondents	1,672	1,672	1,672	1,672

Note: This table summarises the general POS payment habits of the respondents in terms of frequency of payment instrument use. Percentages represent shares of respondents. Data are weighted by age, gender and education.

Turning to the respondents' perception of the safety of the main POS payment instruments, they were asked to rate the safety of cash, the debit card, the credit card and the e-purse, while making a distinction between *using* it at the POS and *carrying* it. In addition, we asked the respondents to assess the safety of ATM cash withdrawals. In all cases, the respondents were asked to provide a rate on the following scale: 1 (very unsafe), 2 (unsafe), 3 (little unsafe), 4 (neutral), 5 (little safe), 6 (safe), and 7 (very safe). Category 4 (neutral) could be used if respondents had a neutral stance, i.e. if payment instruments were perceived as neither unsafe nor safe. In case respondents were unable to provide an answer because they had no opinion, for example because they had never used a particular payment instrument, they were able to use a separate category 'I do not know'. We will exclude this latter category from all further analyses.[9]

Table 4.3 presents the weighted average ratings provided by the respon-

[9]The share of 'I do not know' turned out to be limited for the questions related to cash, the debit card and ATM withdrawals. It was relatively high for the e-purse and the credit card. Given the limited use of these latter two instruments in the Netherlands, this finding confirms that the answer 'I do not know' was mainly used because of a lack of user experience.

Table 4.3: Perceived safety of POS payment instruments

	Cash		Debit card		E-purse		Credit card		ATM
	Carry	Use	Carry	Use	Carry	Use	Carry	Use	With-drawals
Perceived safety (1 - 7):									
Sample mean	4.89	5.37	5.26	5.31	5.29	5.39	4.93	5.07	4.91
Standard error	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.04	0.03
% Unsafe	9%	2%	3%	4%	4%	3%	9%	6%	10%
No. respondents	1,664	1,664	1,630	1,624	823	793	869	812	1,656

Note: This table presents the sample means and standard errors of the safety scores reported by the respondents for various payment aspects on a scale from 1 (very unsafe) to 7 (very safe). Two-sample t-tests show that all sample means significantly differ from each other at a 1% significance level. % Unsafe shows the percentage of respondents who reported a score of 1 (very unsafe), 2 (unsafe) or 3 (little unsafe). Data are weighted by age, gender and education.

dents, as well as the percentage shares of respondents that were dissatisfied with the safety levels concerned. On average, Dutch consumers have a positive stance towards the safety of the various POS instruments. Overall, the average ratings fluctuate between 4.89 to 5.39. There are, however, small but significant differences among the different means of payment and between *using* and *carrying* them.[10] For cash, the debit card, the credit card, as well as the e-purse, consumers feel less secure when carrying it than when using it. Second, the data suggest that the respondents feel most secure when carrying an e-purse or a debit card, whereas cash and the e-purse are perceived as being the safest instruments with which to pay. Also, the results point to a relatively high discomfort with both carrying and using a credit card, carrying cash and ATM withdrawals, as around 10% of respondents perceive these payment aspects as unsafe.

Subsequently, we asked the respondents to rate the likelihood, as well as the seriousness of various payment instrument-related incidents on the following scale: 1 (very low), 2 (low), 3 (neutral), 4 (high), and 5 (very high). Again, the middle category (neutral) could be used if the likelihood and seriousness were perceived as neither low nor high. In case respondents were unable to provide an answer because they had no opinion, for example because they did not know what a particular payment incident involved, they were able to use a separate category 'I do not know', which we will exclude from all further analyses.[11] Depending on the payment instrument in question, we asked the respondents to rate the likelihood and consequences of the most commonly experienced (or perceived) incidents in the Netherlands (see Table 4.4). For ATM withdrawals, we distinguished between the card being skimmed and the PIN being spied at the ATM. As regards potential incidents resulting from carrying a particular instrument,

[10] We conducted two-sample t-tests, which showed that all weighted average scores significantly differed from each other at a 1% significance level.

[11] Again, the share of 'I do not know' turned out to be relatively high only for the incidents related to the e-purse and the credit card. Given the limited use of these payment instruments in the Netherlands, this finding suggests that the answer 'I do not know' was mainly used because of a lack of user experience.

Table 4.4: Perceived likelihood and consequences of payment incidents

Incident	Perceived likelihood		Perceived consequences	
	Sample mean (1 - 5)	No. Obs.	Sample mean (1 - 5)	No. Obs.
ATM withdrawals:				
Skimming	2.49	1,587	3.79	1,587
PIN spying	2.57	1,618	3.50	1,600
Cash:				
Falsification	2.56	1,617	3.27	1,616
Too little change	2.43	1,649	2.60	1,644
Pickpockets	2.76	1,631	3.41	1,626
Violent robbery	2.47	1,621	3.96	1,638
Loss	2.66	1,646	3.17	1,647
Debit card:				
Skimming	2.25	1,581	3.73	1,588
PIN spying	2.68	1,614	3.49	1,594
Erroneous debits	1.91	1,602	3.16	1,594
Pickpockets	2.76	1,631	3.61	1,595
Violent robbery	2.47	1,621	4.26	1,596
Loss	2.66	1,646	3.22	1,618
E-purse:				
Skimming	2.07	798	2.96	800
Erroneous debits	1.78	813	2.91	802
Pickpockets	2.76	1,631	3.03	816
Violent robbery	2.47	1,621	3.68	819
Loss	2.66	1,646	2.86	828
Credit card:				
Skimming	2.38	849	3.80	853
Erroneous debits	2.07	857	3.27	854
Pickpockets	2.76	1,631	3.92	868
Violent robbery	2.47	1,621	4.19	852
Loss	2.66	1,646	3.60	869

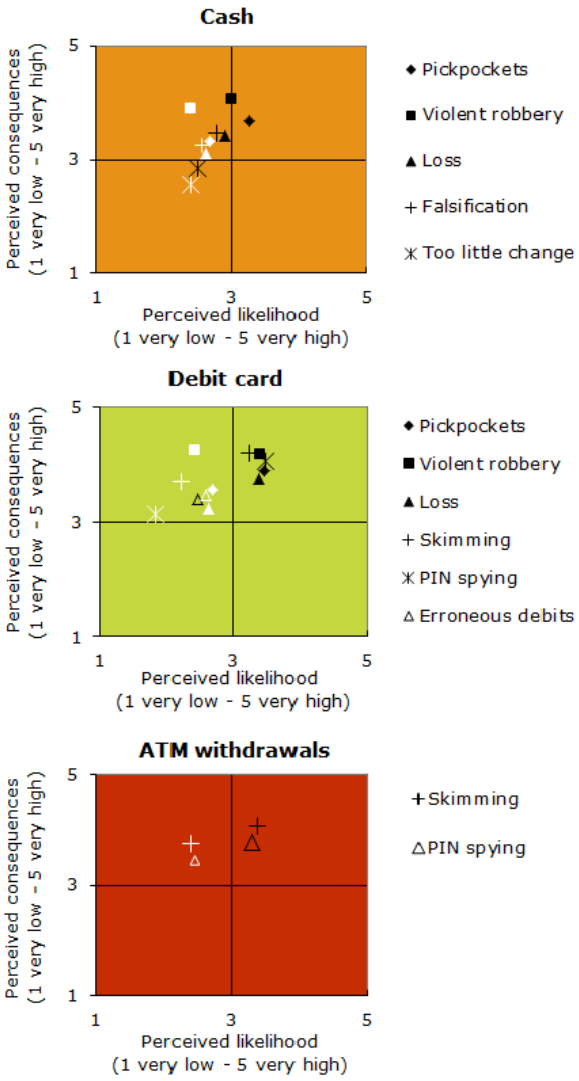
Note: This table presents the sample means of the scores reported by the respondents for the perceived likelihood and consequences of various payment instrument-related incidents on a scale from 1 (very low) to 5 (very high). No. Obs. reflects the number of observations. Data are weighted by age, gender and education.

we differentiated between accidentally losing it, being pickpocketed and being violently robbed. Finally, we considered various incidents related to the use of the instruments at the POS, such as receiving counterfeit banknotes or too little change when paying in cash, the card or chip being skimmed or a wrong amount being debited when paying by debit card, e-purse or credit card, and the PIN being spied when entering it for a debit card payment. The results are summarised in Table 4.4 and show that the average likelihood scores vary between 1.78 for erroneous debits and 2.76 for being pickpocketed. This suggests that consumers believe that the likelihood of falling victim to a certain payment incident is relatively small. By contrast, the consequences of potential incidents are perceived as rather serious. Here, the average scores fluctuate between 2.60 for receiving too little change and 4.26 for violent robberies.

The results point to a certain deviation between consumers' perceptions and reality. That is, the probability of falsification is perceived as higher than the probability of debit card skimming fraud. In reality, however, the likelihood of encountering a counterfeit banknote is considerably smaller (see Section 4.2.1). Another notable result is that consumers have a perception of both the likelihood and the consequences of e-purse skimming fraud, whereas in fact this type of fraud does not exist. This misperception may be explained by the fact that the e-purse product is based on a chip, which for most cardholders is embedded in the same card they use for their debit card transactions. Whereas the magnetic stripe on the card is vulnerable to skimming, consumers are apparently not aware that the chip is not. These findings hint at a certain lack of information and knowledge about the actual probabilities and the actual consequences of incidents related to the use of payment instruments.

In order to get a first impression of any correlation between consumers' views on the overall safety level of a payment instrument and their perception of the likelihood and seriousness of potential incidents, Figure 4.1 presents three scatter plots: one for each of the two main POS instruments,

Figure 4.1: Perceived likelihood and consequences of payment incidents



Note: This figure presents the average 'likelihood' and 'consequences' scores for various cash, debit card and ATM incidents. The black symbols refer to the respondents rating the safety of the corresponding payment instrument with a 1 (very unsafe), 2 (unsafe) or 3 (little unsafe). The white symbols refer to those giving a score of 4 (neutral), 5 (little safe), 6 (safe) or 7 (very safe).

i.e. cash and the debit card, and one for ATM withdrawals. Each plot shows the average 'likelihood' and 'consequences' scores given by the respondents for various related incidents, while making a distinction between the average scores of respondents who perceived the particular payment instrument as unsafe (the black symbols), and the average scores of those who perceived the instrument as safe (the white symbols).[12] Overall, the three scatter plots present the same picture and suggest that the two-step approach commonly used in other research fields (see Section 4.2.2) may also be used for modelling risks and behaviour in the area of retail payments. That is, for both cash and the debit card, as well as for ATM withdrawals, respondents who are satisfied with their overall safety level not only perceive the likelihood of potential incidents as lower than those who are not, but also the consequences as less serious. All three plots, however, suggest that the largest difference is in the likelihood assessment. This is an interesting finding, as it indicates that consumers' views on the safety of payment instruments is influenced mainly by their perception of the likelihood of potential losses and fraud, and to a lesser extent by their views on the severity of the consequences. In Section 4.4.1 we will use econometric estimation techniques to examine this issue more formally.

Finally, we asked the respondents about any personal experiences with losses or fraud resulting from *using* or *carrying* a POS payment instrument. The results are summarised in Table 4.5 and show that only a few have ever been involved in a payments-related safety incident. Moreover, the results demonstrate that the incidents most experienced relate to the carriage of

[12]The black symbols refer to the respondents who rated the safety level of cash, the debit card and ATM withdrawals with a score of 1 (very unsafe), 2 (unsafe) or 3 (little unsafe). The white symbols refer to those who gave a score of 4 (neutral), 5 (little safe), 6 (safe) or 7 (very safe). The black/white distinction for pickpockets, violent robbery and loss of cash is based on consumers' safety assessment of *carrying* cash. For falsification and too little change, the distinction is based on the perceived safety of *using* it. The distinction for pickpockets, violent robbery and loss of the debit card is based on the perceived safety of *carrying* the debit card. For skimming, PIN spying and erroneous debits, the distinction is based on the assessment of *using* it. The distinction in the ATM graph is based on consumers' overall safety assessment of ATM withdrawals.

Table 4.5: Personal experiences with payment incidents

Incident	Share of respondents with experiences
ATM withdrawals:	
Skimming	2%
PIN spying	5%
Carrying payment instruments:	
Pickpockets	16%
Violent robbery	3%
Loss	31%
Cash:	
Falsification	12%
Too little change	55%
Debit card:	
Skimming	2%
PIN spying	8%
Erroneous debits	5%
E-purse:	
Erroneous debits	2%
Credit card:	
Skimming	4%
Erroneous debits	10%

Note: Data are weighted by age, gender and education.

a payment instrument, i.e. loss and theft. With the exception of receiving too little change, only a few respondents have ever sustained losses resulting from withdrawing money at an ATM or from paying at the POS.

4.3.3 Empirical model and estimation method

In order to formally examine the determinants of consumers' views on the safety of POS payment instruments and to assess the impact of perceived safety on payment choices, we employ the survey data for various empirical analyses. Given the limited use of the e-purse and the credit card, we focus on cash and debit cards only. The analysis is split up in three parts. First, we formally assess how consumers' beliefs about the safety of cash and

debit cards are influenced by their perception of the likelihood and severity of potential incidents. We estimate three separate models with the overall perceived safety level of cash ($CASHsafe$), the debit card ($DCsafe$) and ATM withdrawals ($ATMsafe$) being the respective dependent variables. The perceived safety level of ATM withdrawals is taken directly from the survey data. However, as described in Section 4.3.2, for cash and debit cards the respondents provided two separate safety scores, i.e. one for using it and one for carrying it. Therefore, we calculate the average of both scores and round it up to the nearest integer. As a result, each of the three dependent variables may take on seven different values, from 1 (very unsafe) to 7 (very safe). As there clearly exists a natural ordering of the seven answers, ordered response estimation techniques are appropriate.[13] Therefore, we estimate three Ordered Probit models.[14] In each model, the dependent variable is first of all regressed upon the following dummy variables: (i) a dummy indicating whether respondents perceived the likelihood of related payment incidents to be high or not (i.e. $llhCASH$ in the cash model, $llhDC$ in the debit card model and $llhATM$ in the ATM model), and (ii) a dummy indicating whether they perceived the potential consequences as severe or not (i.e. $impCASH$ in the cash model, $impDC$ in the debit card model and $impATM$ in the ATM model). The 'likelihood' dummies each take on a value of one when the average of the various 'likelihood' scores given by the respondents for related payment incidents equals 4 (high) or 5 (very high) when rounded up to the nearest integer. Otherwise the dummies take on a value of zero. Similarly, the 'consequences' dummies each take on a value of one when the rounded average of the various 'consequences' scores for related payment incidents equals 4 (high) or 5 (very high), and zero

[13] See, for example, Verbeek (2000).

[14] Ordered Probit models assume a standard normal distribution. Alternatively, Ordered Logit models can be used assuming a logistic distribution. As the two distributions are very similar, Probit and Logit models typically yield very similar results. Indeed, additional analyses demonstrated that the signs of the coefficients are identical across the two different specifications. Moreover, the statistical significance of the explanatory variables turned out to be virtually identical.

otherwise. Moreover, as the effect of perceived likelihoods on consumers' overall safety perception may depend on the perception of consequences and vice versa, we also include an interaction term of both dummy variables ($llhCASH^{*}impCASH$, $llhDC^{*}impDC$, $llhATM^{*}impATM$ respectively). Finally, we incorporate a risk aversion dummy ($Risk$) into each model to account for the fact that respondents may differ in their attitudes towards risks in general. This dummy takes on a value of one if respondents agreed to the following statement: "I would never consider investments in shares because I find this too risky", and zero otherwise. Consequently, the three Ordered Probit models, of which the results are presented and discussed in Section 4.4.1, can be summarised as follows:

$$CASHsafe = CASHsafe(llhCASH, impCASH, llhCASH^{*}impCASH, Risk) \tag{4.1}$$

$$DCsafe = DCsafe(llhDC, impDC, llhDC^{*}impDC, Risk) \tag{4.2}$$

$$ATMsafe = ATMsafe(llhATM, impATM, llhATM^{*}impATM, Risk) \tag{4.3}$$

Since the literature suggests that consumers are heterogeneous in their perceptions of safety (see Section 4.2.2), as a second step we assess the role of personal characteristics in consumers' assessment of probabilities and consequences. Also, we analyse how consumers' views vary with personal experiences, as people who have ever experienced losses or fraud resulting from using or carrying a POS payment instrument may have different perceptions of the likelihood and seriousness of incidents than those who have not. Again, we estimate three separate models, i.e. one for cash, one for

the debit card and one for ATM withdrawals. Each model contains two dependent variables: (i) the dummy variable mentioned above indicating whether consumers perceived the likelihood of related payment incidents to be high or not (i.e. $llhCASH$, $llhDC$ and $llhATM$ respectively), and (ii) the above-described dummy variable indicating whether they perceived the potential consequences to be severe or not (i.e. $impCASH$, $impDC$ and $impATM$ respectively). Each dependent variable thus has two possible outcomes. A common approach for modelling limited dependent variables of this kind is to use a binary choice model.[15] Therefore, we estimate three Probit models.[16] As the two dependent variables, i.e. the perceived likelihood and the perceived consequences, may potentially be correlated, it may be appropriate to jointly estimate both variables and to use a multivariate Probit model. Therefore, we use Bivariate Probit regression techniques. Hence, in each model, the two dependent variables are simultaneously regressed upon the same set of regressors. First of all, they are regressed upon three dummies identifying whether consumers have ever been involved in a cash ($CASHexp$), debit card ($DCexp$) or ATM ($ATMexp$) incident. Also, we add dummy variables for the consumer's gender (Sex), age category (Age), urbanisation degree of region of residence (Urb), income category (Inc) and education category (Edu). Consequently, the three Bivariate Probit models, of which the results are presented and discussed in Section 4.4.1, can be summarised as follows:

The cash model:

$$llhCASH = llhCASH(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.4a}$$

[15] See, for example, Verbeek (2000).

[16] Probit models assume a standard normal distribution. Alternatively, Logit models can be used assuming a logistic distribution. Additional analyses demonstrated that the signs of the coefficients are identical across the two different specifications. Moreover, the statistical significance of the explanatory variables turned out to be virtually identical.

$$impCASH = impCASH(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.4b}$$

The debit card model:

$$llhDC = llhDC(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.5a}$$

$$impDC = impDC(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.5b}$$

The ATM withdrawals model:

$$llhATM = llhATM(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.6a}$$

$$impATM = impATM(CASHexp, DCexp, ATMexp, Sex, Age, Urb, Inc, Edu) \tag{4.6b}$$

As a final step, we assess the impact of consumers' safety perception of cash and debit cards on their general POS payment behaviour. To this end, we split our sample into three types of payers: (i) frequent cash users,

which we define as consumers who pay more frequently in cash than by debit card ($CASHpref$), (ii) frequent debit card users, which we define as consumers who more often use a debit card than cash ($DCpref$), and (iii) consumers who have no particular preference and use cash and debit cards to the same extent ($NOpref$). Of all respondents, one-third can be classified as a frequent cash user, 30% prefer to pay by debit card and 38% have no particular preference. Since we distinguish between more than two different types of payers, and as there is no natural ordering between them, a multinomial response model is to be used to assess whether consumers' views on the safety of cash and debit cards significantly affect the probability of being a frequent cash or a frequent debit card user.[17] Therefore, we use a Multinomial Probit model.[18] The dependent variable is the type of payer the respondent is assigned to ($Payer$) based on the above-mentioned criteria, being either $CASHpref$, $DCpref$ or $NOpref$. The model contains various explanatory variables. First, we use three dummies indicating whether the respondent perceives cash, debit cards and ATM withdrawals as unsafe or not. The dummy variable $ATMunsafe$ takes on a value of one in case the safety of ATM withdrawals is rated with a score of 1 (very unsafe), 2 (unsafe) or 3 (little unsafe), and zero otherwise. The dummies $DCunsafe$ and $CASHunsafe$ equal one in case the rounded average of the safety scores for using and carrying the debit card and cash respectively is 1 (very unsafe), 2 (unsafe) or 3 (little unsafe), and zero otherwise. In addition, the model contains various dummy variables to account for personal characteristics, such as gender (Sex), age category (Age), urbanisation degree of region of residence (Urb), income category (Inc) and education category (Edu). Consequently, the Multinomial Probit model, of which the results are presented and discussed in Section 4.4.2, can be summarised

[17] See, for example, Verbeek (2000).

[18] This model assumes a standard normal distribution. Alternatively, a Multinomial Logit model can be used assuming a logistic distribution. Additional analyses demonstrated that the signs of the coefficients are identical across the two different specifications. Moreover, the statistical significance of the explanatory variables turned out to be virtually identical.

as follows:

$$Payer = Payer(CASHunsafe, DCunsafe, ATMunsafe, Sex, Age, Urb, Inc, Edu) \quad (4.7)$$

4.4 Results

4.4.1 Consumers' perception of safety

Table 4.6 shows the parameter estimates and standard errors of the three Ordered Probit models. Whereas the estimated coefficients of Ordered Probit models have no direct interpretation, their signs and significance have. The results confirm the preliminary conclusions drawn from the scatter plots in Figure 4.1 that consumers' views on the safety of payment instruments are influenced mainly by their perception of the probability of incidents occurring. In each of the three models, the 'Perceived likelihood' dummy has a significant negative sign, which indicates that consumers who believe the likelihood of falling victim to respectively a cash, debit card or an ATM incident is high, are more likely to perceive the particular payment instrument as unsafe. Turning to the perceived consequences of possible incidents, the results demonstrate that they are also considered by consumers, though to a lesser degree. All models show a negative effect of 'Perceived consequences'. However, the effect is only significantly different from zero in the cash model. This suggests that consumers are more probable to perceive cash as unsafe when they perceive the consequences of potential cash incidents as severe. Also, the significant negative interaction term in the debit card model points to a significant effect of perceived consequences. It suggests that the negative effect of 'Perceived likelihood' on consumers' safety perception is stronger for people who also perceive

Table 4.6: Impact of perceived probabilities and consequences

	(1) CASHsafe	(2) DCsafe	(3) ATMsafe
Perceived likelihood of incidents	−0.511***	−0.386**	−0.774***
	0.119	*0.166*	*0.205*
Perceived consequences of incidents	−0.122*	−0.034	−0.022
	0.064	*0.070*	*0.069*
Likelihood * Consequences	0.100	−0.387**	−0.038
	0.135	*0.177*	*0.215*
Risk aversion	−0.080	−0.141***	−0.124**
	0.053	*0.053*	*0.053*
Variance inflation factors (VIF)			
Perceived likelihood of incidents	4.69	9.12	11.81
Perceived consequences of incidents	1.35	1.24	1.15
Likelihood * Consequences	5.41	9.77	12.31
Risk aversion	1.01	1.01	1.01
No. Observations	1,672	1,672	1,656
LR chi2(4)	75.26	189.78	184.50
Prob. > chi2	0.0000	0.0000	0.0000
Pseudo R2	0.0154	0.0371	0.0360

Note: This table presents the parameter estimates, standard errors (in italics) and variance inflation factors of the three Ordered Probit models, with $CASHsafe$, $DCsafe$ and $ATMsafe$ being the dependent variables reflecting from 1 (very unsafe) to 7 (very safe) the overall perceived safety level of cash, debit cards and ATM withdrawals respectively. 'Perceived likelihood of incidents' and 'Perceived consequences of incidents' equal 1 if the rounded average of the respective likelihood and consequences scores given for related payment incidents equals 4 (high) or 5 (very high), and 0 otherwise. 'Likelihood * Consequences' equals 1 in case both the likelihood and consequences of related payment incidents are perceived to be high, and 0 otherwise. 'Risk aversion' equals 1 if respondents agreed to the following statement: "I would never consider investments in shares because I find this too risky", and 0 otherwise. ***/**/* denotes significance at the 1%/5%/10% level respectively.

the potential consequences as high.[19] Finally, both the debit card and the ATM withdrawals model point to a significant negative effect of the risk aversion indicator. This suggests that people who are more risk averse in general are more likely to believe that debit cards and ATM withdrawals are unsafe, irrespective of how they assess the probability of occurrence and the severity of potential safety incidents.

As multiplicative interaction models should always include all variables that constitute the interaction terms, by construct they are vulnerable to multicollinearity. Despite the fact that various papers argue that the problem of multicollinearity in multiplicative interaction models has been overstated (e.g. Brambor et al. (2006), Friedrich (1982)), we further explored this issue by computing the variance inflation factors (VIF) as an indication of the correlation between the individual explanatory variables and the other regressors. Although there is no formal VIF value for determining the presence of multicollinearity, values larger than 10 are often regarded as a signal. As we find VIF values fluctuating around 10 in the debit card and ATM model, we re-ran the models without including the interaction terms. The significance and signs of the other variables turned out to be virtually identical. Moreover, the estimation results do not show unexpected signs or inordinate standard errors when including the interaction terms. Therefore, we do not believe the problem of multicollinearity to have seriously harmed the results.[20]

Turning to the role of personal experiences and personal characteristics in consumers' perception of the probability and seriousness of payment incidents, Table 4.7 presents the parameter estimates of the three Bivariate Probit models. The estimated *Rho's* are significantly different from zero

[19] See Brambor, Clark and Golder (2006) for a detailed account of the interpretation of multiplicative interaction effects. Yet, the interaction effects are to be interpreted with some caution. As explained in Norton, Wang and Ai (2004), the magnitude and statistical significance of interaction terms, either between two dummies or between two continuous variables, may range widely across observations in Logit and Probit models. Nevertheless, the significant negative effect in the debit card model shows that, on average, there is a significant interaction between the two underlying dummies.

[20] See Maddala (1992) for a further discussion on multicollinearity.

Table 4.7: Role of personal experiences and personal characteristics

	Cash Model			Debit Card Model			ATM Withdrawals Model		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	llhCASH	impCASH	Marginal effects	llhDC	impDC	Marginal effects	llhATM	impATM	Marginal effects
Constant	−0.261	0.318		−0.279	0.356		−0.336	0.252	
Personal experiences:									
ATM incidents	0.325***	−0.153	0.054	0.587***	0.138	0.178***	0.824***	0.017***	0.194***
Cash incidents	0.346***	0.260***	0.132***	−0.033	0.499	0.036	−0.107	0.479***	0.013
Debit card incidents	−0.015	−0.024	0.007	0.279***	0.044***	0.067**	0.119	0.038	0.035
Gender	0.162**	0.312***	0.085***	0.203***	0.326***	0.097***	0.204***	0.253***	0.083***
Age:									
25 - 34	−0.291	0.181	−0.059	−0.165	−0.102	−0.054	−0.038	0.167	0.008
35 - 44	−0.195	0.378**	−0.018	−0.078	0.187	−0.002	−0.033	0.393**	0.030
45 - 54	−0.323*	0.237	−0.064	−0.167	−0.058	−0.050	−0.037	0.154	0.007
55 - 64	−0.269	0.358**	−0.041	−0.169	0.086	−0.037	0.083	0.158	0.041
Over 65	−0.170	0.153	−0.029	−0.012	−0.007	−0.004	0.083	0.037	0.026
Living environment:									
Enormously urbanised	0.265**	0.104	0.086**	0.158	−0.064	0.033	0.067	−0.047	0.011
Strongly urbanised	0.264**	0.105	0.085**	0.188*	0.019	0.053	0.154	0.087	0.051
Moderately urbanised	0.279**	0.051	0.081**	0.249**	0.053	0.074**	0.162	0.145	0.061
Little urbanised	0.185*	−0.047	0.040	0.208*	0.124	0.074**	0.093	−0.066	0.014
Net montly income (EUR):									
1,151 - 1,800	−0.548***	−0.549***	−0.174***	−0.336**	−0.267	−0.110**	−0.602***	−0.116	−0.145***
1,801 - 2,600	−0.330**	−0.436***	−0.126***	−0.184	−0.206	−0.070	−0.425***	−0.002	−0.102**
More than 2,600	−0.415***	−0.521***	−0.150***	−0.331**	−0.292*	−0.112**	−0.648***	−0.129	−0.154***
Education:									
Lower secondary	0.011	−0.003	0.002	−0.080	0.162	−0.005	0.017	−0.002	0.004
Higher secondary	−0.221	0.091	−0.048	−0.363**	0.143	−0.084*	−0.352**	0.066	−0.081
Intermediate vocational	−0.010	0.160	0.015	−0.164	0.322**	−0.017	−0.021	0.133	0.009
Higher vocational	−0.313**	−0.060	−0.085*	−0.426***	0.193	−0.098**	−0.164	0.008	−0.040
University	−0.313*	−0.073	−0.086*	−0.664***	0.236	−0.153***	−0.409**	0.093	−0.093*
No. Observations			1,672			1,672			1,672
Wald chi2(42)			149.72			195.24			211.42
Prob. > chi2			0.0000			0.0000			0.0000
Rho			0.3767			0.4128			0.4311
Test rho=0 Prob. > chi2			0.0000			0.0000			0.0000
Prob. (llh=1 and imp=1)			0.3034			0.3086			0.2842

Note: Columns 1, 2, 4, 5, 7 and 8 present the parameter estimates of the three Bivariate Probit regressions, with the perceived likelihoods (i.e. $llhCASH$, $llhDC$ and $llhATM$) and the perceived consequences (i.e. $impCASH$, $impDC$ and $impATM$) of related incidents being the two dependent variables. Columns 3, 6 and 9 present the changes in the predicted probability of a person perceiving both the likelihood and the impact of possible incidents to be high for a change in the explanatory dummies from 0 to 1 holding all other variables constant at their reference points. These marginal effects should be interpreted relative to the reference category, i.e. a man having no personal experiences with payment incidents, being younger than 25 years, living in a non-urbanised area, earning less than EUR 1,150 per month and only having primary education. This reference person has a predicted probability of 'Prob. (llh=1 and imp=1)' to perceive both the likelihood and the impact of possible incidents to be high (last row). ***/**/* denotes significance at the 1%/5%/10% level respectively.

in each model. This implies that there is an efficiency gain in jointly estimating perceptions of likelihoods and perceptions of consequences using a Bivariate Probit model instead of a regular Probit model. Similar to the coefficients of an Ordered Probit model, apart from their signs, the coefficients of a Bivariate Probit model are not easy to interpret. One way to interpret the parameters is to look at their marginal effects. Therefore, Columns 3, 6 and 9 present the changes in the predicted probability that a person perceives both the likelihood and the impact of related incidents to be high for a change in each of the explanatory dummies from 0 to 1 leaving all other variables unchanged. The marginal effects should be interpreted relative to the reference category, i.e. a man having no personal experiences with payment incidents, being younger than 25 years, living in a non-urbanised area, earning less than EUR 1,150 per month and only having primary education, who, according to the last row in Table 4.7, has a predicted probability of around 30% of perceiving both the likelihood and the consequences of cash, debit card and ATM incidents as high.

First, the findings clearly show that personal experiences significantly influence consumers' perceptions. People who have been involved in an incident with cash in the past are 13 percentage points (pp.) more likely to perceive both the probability and the consequences of cash incidents as high compared to people without such experiences. Similarly, those who have ever fallen victim to respectively a debit card and an ATM incident are 7 pp. and 19 pp. more probable to believe that the likelihood and severity of these incidents are high. Interestingly, past experiences with cash incidents do not significantly influence consumers' views on potential debit card incidents, and vice versa. This may indicate that consumers see cash and debit cards as two distinct means of payment. With respect to ATM withdrawals, however, the parameter estimates and marginal effects do point to a significant interaction. People who have been involved in a cash incident are significantly more likely to perceive ATM incidents as severe. Similarly, those who have been involved in an ATM incident are

significantly more inclined to believe that the likelihood of something to happen when using or carrying cash or a debit card is high. This suggests that consumers perceive a strong association between ATM withdrawals on the one hand and cash and debit cards on the other. This may be explained by the fact that in the Netherlands, the majority of cash is withdrawn from an ATM instead of a bank teller. Moreover, there are no special ATM cards, i.e. consumers are able to withdraw money using their regular debit card. Therefore, ATM withdrawals are necessary for carrying and using cash, whereas a debit card is needed to withdraw the cash from the ATM.

Second, Table 4.7 confirms that personal characteristics too have a strong and significant impact on consumers' safety perception. The marginal effects in Columns 3, 6 and 9 show that women are nearly 10 pp. more likely than men to believe that both the probability and the impact of cash, debit card and ATM incidents are severe. The finding that men perceive risks as lower than women has also been established elsewhere in the literature (e.g. Sapp (2003), Wildavsky and Dake (1990)). Moreover, people aged between 35 and 44 and between 55 and 64 more often believe that cash and ATM incidents will have serious consequences compared to people younger than 25 years. Furthermore, the significant negative marginal effects of 10 pp. and more show that, as opposed to people from the lowest income category, higher-income people tend to think less seriously about the likelihood and severity of cash incidents and about the likelihood of debit card and ATM incidents. In addition, the perceived likelihood of being involved in a cash or a debit card incident significantly increases with the urbanisation degree of a person's living environment. At last, education plays a significant role, with higher-educated people being less inclined to rate the likelihood and impact of cash, debit card and ATM incidents to be severe than lower educated people. For instance, compared to persons having a primary education only, people with a university degree are 9 pp. and 15 pp. less probable to think that the likelihood that something serious happens when using or carrying cash or a debit card is high.

4.4.2 Safety perception and payment choices

The results presented in Section 4.4.1 demonstrate that consumers' views on the safety of cash, debit cards and ATM withdrawals are influenced mainly by their perception of the probability of incidents occurring, which in turn is influenced by past experiences and personal characteristics. Given this background, we turn to answering the last research question of this chapter as to how this affects consumers' payment behaviour at the POS. Table 4.8 presents the results of the Multinomial Probit model estimated to assess whether consumers' views on the safety of cash and debit cards significantly affect the probability of being a frequent cash or a frequent debit card user. Similar to the coefficients of an Ordered and a Bivariate Probit model, apart from their signs, the coefficients presented in Columns 1 and 3 are not easy to interpret. Therefore, Columns 2 and 4 present their marginal effects, i.e. the changes in the predicted probability that a person is a frequent cash or a frequent debit card user instead of having no particular preference for a change in each of the explanatory dummies from 0 to 1 holding all other variables constant. These marginal effects should be interpreted relative to the reference category, i.e. a man perceiving cash, debit cards and ATM withdrawals as safe, being younger than 25 years, living in a non-urbanised area, earning less than EUR 1,150 per month and only having primary education. This reference person has, according to the last two rows in Table 4.8, a predicted probability of 59% and 16% of being a frequent cash and a frequent debit card user respectively.

The estimation results confirm the general conclusion from the literature that perceptions of risks negatively influence behaviour. Changes in the perceived safety level of cash are shown to significantly affect consumers' preferences for cash. The marginal effect in Column 2 shows that people who believe paying in cash is unsafe, are 21 pp. less likely to be a frequent cash user. Similarly, those who believe debit cards are unsafe are 11 pp. less likely to frequently pay by debit card (Column 4). Second, the results point to a strong and significant substitution effect from cash to debit cards.

Table 4.8: Impact of safety perception on cash and debit card use

	CASHpref		DCpref	
	(1)	(2)	(3)	(4)
	Coefficients	Marginal effects	Coefficients	Marginal effects
Constant	0.717**		−0.290	
Dissatisfaction with safety:				
ATM withdrawals	0.333*	0.039	0.421**	0.039
Debit cards	−0.062	0.056	−0.846***	−0.110***
Cash	−0.441**	−0.206***	0.487**	0.183***
Gender	0.085	0.036	−0.093	−0.027
Age:				
25 - 34	−0.728***	−0.258***	0.277	0.167***
35 - 44	−0.439*	−0.167**	0.239	0.115**
45 - 54	−0.180	−0.048	−0.049	0.013
55 - 64	−0.063	−0.037	0.134	0.036
Over 65	0.173	0.034	0.130	0.003
Living environment:				
Enormously urbanised	0.162	0.075*	−0.260	−0.061**
Strongly urbanised	0.044	0.033	−0.169	−0.035
Moderately urbanised	−0.024	0.019	−0.229	−0.038
Little urbanised	−0.067	0.007	−0.232	−0.034
Income (EUR):				
1,151 - 1,800	−0.349	−0.089	−0.146	0.014
1,801 - 2,600	−0.601***	−0.169***	−0.111	0.051
More than 2,600	−0.550***	−0.157***	−0.082	0.051
Education:				
Lower secondary	−0.206	−0.105*	0.296	0.095*
Higher secondary	−0.183	−0.120*	0.439*	0.128**
Intermediate vocational	−0.282	−0.121**	0.256	0.096*
Higher vocational	−0.358	−0.141**	0.231	0.101**
University	−0.431*	−0.125*	−0.054	0.043
No. Observations				1,672
Wald chi2(42)				120.98
Prob. > chi2				0.0000
Prob. (CASHpref=1)				0.5896
Prob. (DCpref=1)				0.1639

Note: Columns 1 and 3 in this table present the estimated coefficients of the Multinomial Probit regression. The dependent variable takes on three outcomes, i.e. $CASHpref$, $DCpref$ or $NOpref$, which equal 1 for frequent cash users, frequent debit card users and persons with no preference respectively. Results should be interpreted as changes relative to the $NOpref$ alternative. The reference category is a man perceiving cash, debit cards and ATM withdrawals as safe, being younger than 25 years, living in a non-urbanised area, earning less than EUR 1,150 per month and only having primary education. The dummies 'ATM withdrawals', 'Debit cards' and 'Cash' equal 1 if their overall safety scores are 1 (very unsafe), 2 (unsafe) or 3 (little unsafe), and 0 otherwise. Prob. (CASHpref=1) and Prob. (DCpref=1) reflect predicted probabilities of a reference person being a frequent cash or a frequent debit card user respectively. The marginal effects in Columns 2 and 4 reflect the changes in this probability for a change in the explanatory dummies from 0 to 1 holding all other variables constant at their reference points. ***/**/* denotes significance at the 1%/5%/10% level respectively.

People who think that cash is unsafe are 18 pp. more likely to more often pay by debit card than in cash. These findings are robust to controlling for various personal characteristics. Here, the estimation results confirm the conclusions drawn in earlier payment studies (see Chapter 1), that younger and more educated consumers with higher incomes are more likely to pay by card instead of cash than their counterparts.

4.5 Conclusions

In this chapter we analysed 2008 survey data collected among more than 1,600 Dutch consumers to investigate the role of perceived payments safety in consumers' choice between POS payment instruments. To this end, we first examined the determinants of consumers' views on the safety of cash, debit cards and ATM withdrawals. Following the approach commonly used in other fields of research of separating the probability of losses and the severity given losses, we used Ordered Probit estimation techniques to assess how consumers' views on safety are influenced by their perception of both the probability and the seriousness of potential cash, debit card and ATM incidents. Here our key finding is that consumers' views on the safety of cash, debit cards and ATM withdrawals are influenced mainly by their perception of the probability of incidents occurring. As demonstrated in other research fields, the severity of the consequences is also considered by consumers, though to a much lesser degree. Second, we estimated various Bivariate Probit models and confirm that beliefs about safety are influenced by experiences and personal characteristics. People who have ever been involved in a payment incident, as well as women, people living in urbanised areas and lower educated and lower income people think more seriously about the likelihood and severity of payment incidents compared to their counterparts. Finally, we estimated a Multinomial Probit model to examine the impact of consumers' safety perception on the use of cash and debit cards and present evidence suggesting that the choice between POS

payment instruments is significantly influenced by perceptions of safety. We show that people who perceive cash as unsafe are less likely to use it at the POS. Instead, they rather revert to the debit card. Similarly, consumers are less likely to pay by debit card when they are dissatisfied about its safety. These findings are robust to controlling for various personal characteristics and confirm the general conclusion from the literature that perceptions of risks negatively influence behaviour.

The results provide valuable policy implications as to whether and how the use of electronic payment instruments can be further increased. First, the conclusion that perceptions of unsafety negatively influence consumers' payment behaviour, as well as the important effect of personal experiences demonstrate that fraud and safety incidents with electronic payment instruments do have potential to obstruct a further shift towards electronics. This underlines the importance of all stakeholders being constantly ready to reduce fraud and safety risks to a minimum. Second, the conclusion that consumers' perceptions of safety are influenced mainly by their perception of probabilities stresses the importance of safety measures that particularly aim at *ex-ante* minimising the probabilities of incidents, instead of *ex-post* mitigating the consequences once they have occurred. Finally, the results suggest that merely taking preventative measures is not enough for preserving consumers' confidence and for further stimulating the use of electronic payment instruments. That is, by showing the importance of consumers' *perceptions* of safety, the findings make clear that it is essential to realise that perceptions may not always reflect reality. Consumers may wrongly perceive certain payment options as (un)safe and, therefore, wrongfully (avoid) use them. Therefore, the results suggest an important role of communication to inform the public about the actual safety level of payment instruments and about the measures taken by the different actors and the steps that consumers can take themselves to minimise payment risks.

Chapter 5

Do newspaper articles on card fraud affect card usage?[1]

Do consumers change their payment behaviour after reading about payments fraud? This chapter analyses this question by studying the impact of newspaper articles about debit card skimming fraud on debit card use in the Netherlands. We use daily card transaction data and daily newspaper announcements from January 1st 2005 to December 31st 2008. Key finding is that skimming fraud articles significantly affect debit card use. The direction and strength of the news effects, however, strongly depend on the specific characteristics of the publications, such as the type of skimming fraud addressed and their position in the newspaper, but above all on the frequency with which they come out. Overall, we find that skimming fraud news depresses same day card usage, with consumers' reactions being stronger in periods when more articles are published. Yet, the effects are economically small and do not sustain or accumulate in the long run.

[1]This chapter is based on Kosse, A. (2013a), Do newspaper articles on card fraud affect debit card usage?, *Journal of Banking & Finance* 37(12): 5382-5391.

'Nothing is older than yesterday's newspaper'
Mark Twain (1835 - 1910)

5.1 Introduction

As thoroughly described in the previous chapter, due to the on-going growth in their acceptance and use, payment cards have increasingly become attractive for fraud, and in particular for skimming fraud. Whereas total fraud losses are still small relative to the total cards turnover, the overall societal consequences could be more widespread. The results in Chapter 4 demonstrate that people who have ever experienced losses or fraud when using or carrying a particular payment instrument, are more likely to perceive this instrument as unsafe and to use other ways of paying. Therefore, as electronic payment instruments are still generally found to be less costly to society than their paper-based counterparts (see Section 1.2.5), skimming fraud incidents may have a substantial effect on the overall social cost efficiency of a retail payment system when causing consumers to move away from paying electronically.

Since research into the impact of fraud and safety is still scarce, Chapter 4 provides new and valuable insights. There is, however, room for further analyses. That is, safety incidents may not only influence consumers' payment behaviour through personal experiences, but also through the media attention they receive. In other fields of research, such as in food, political and economic sciences, media announcements are found to significantly affect consumers' behaviour (e.g Radwan, Gil, Kaabia and Serra (2008), Ching, Clark, Horstmann and Lim (2011), Jansen and de Haan (2007)). In this light, the current chapter further explores the role of fraud and safety in consumers' payment behaviour by examining the impact of newspaper articles about skimming fraud. We use time-series regression techniques to assess how the daily number of debit card payments in the Netherlands is affected by newspaper reports about debit card skimming fraud, after con-

trolling for various calendar, holiday, weather and trend effects. Moreover, we examine to what extent the newspaper effects change over time and how they vary with the type of skimming fraud addressed and their position in the newspaper. In using *actual* transaction data and *actual* newspaper announcements from January 1st 2005 to December 31st 2008, this chapter adds to the previous chapter and to the existing payments literature, which are mainly based on *perceptions* and *stated* behaviour. Moreover, to the best of our knowledge, the impact of media reports on the use of payment instruments has not been studied before. Therefore, this chapter presents new insights into how payment choices are affected by safety incidents, and in particular through the media attention they receive. In doing so, this chapter helps in gaining a deeper understanding of whether and how safety incidents may pose a barrier to further digitisation, and of what measures to take to prevent consumers from reverting to less socially cost efficient means of payment.

The remainder of this chapter is structured as follows. Section 5.2 summarises the relevant literature and presents the main research question. Section 5.3 describes the data and methodology, whereas Section 5.4 reports the results. Section 5.5 summarises and concludes.

5.2 Background and research question

5.2.1 Related literature

Section 4.2.2 showed that research into the area of payments safety is scarce and not reaching a unanimous conclusion. Some papers, such as Alvarez and Lippi (2009), Arango and Taylor (2009), Kahn and Liñares Zegarra (2012), suggest that safety is one of the factors considered when choosing how to pay, whereas others, such as Ching and Hayashi (2010) and Schuh and Stavins (2010), find no evidence of safety playing a role. Therefore, the thorough analyses presented in Chapter 4 provide new and valuable insights. The results demonstrate that consumers are prone to change their

behaviour after experiencing a safety incident with a particular payment instrument. There is, however, scope for further investigation. That is, apart from personal experiences, payment instrument-related safety incidents may also change consumers' behaviour through the media attention they receive. In other fields of research, media communication is found to significantly affect consumers' behaviour. In the 1990s, for example, global food safety concerns dramatically increased due to outbreaks such as of Escherichia coli (E.coli), Salmonella and Boviene Spongiforme Encefalopathie (BSE, or the so-called 'mad cow disease'). As a result, a new stream of literature was introduced investigating the impact of food safety information reported in the media on demand for food. Overall, public information pertaining to food safety and health concerns is shown to depress consumer food demand (e.g. van Ravenswaay and Hoehn (1991), Smith, van Ravenswaay and Thompson (1988), Radwan et al. (2008)). The effects, however, are small compared to other factors, such as price and income effects, seasonal factors and time trends. Also, the studies conclude that the effects are short-lived, with consumers soon forgetting the publicity and reverting back to previous consumption levels. In political, economic and marketing studies too (e.g. Miller, Goldenberg and Erbring (1979), Alsem, Brakman, Hoogduin and Kuper (2008), Campbell, Gordon, Loeb and Zhou (2003), Ching et al. (2011)), consumer confidence and behaviour is found to be significantly affected by media publications. Also here, the effects are often shown to last temporarily and to diminish in the longer run. Similarly, central bank transparency, i.e. the extent to which central banks disclose information related to the monetary policymaking process, has attracted a significant amount of attention in the past two decades (e.g. Jansen and de Haan (2007), van der Cruijsen and Demertzis (2007), Rosa and Verga (2008)). Overall, though small in some cases, there is evidence of a significant communication effect on private agents' behaviour.

Given this background, media reports on payments-related safety concerns may have a considerable effect on the use of payment instruments by

consumers. In particular, the strong growth in news reports about payment card fraud over the past years may have significantly changed consumers' views on and the use of payment cards. Yet, to the best of our knowledge, so far this issue has not been studied before.

5.2.2 Research question

In light of the background provided above, the main objective of this chapter is to further analyse consumers' payment behaviour in relation to safety by answering the following research question: *"What is the impact of newspaper articles about debit card skimming fraud on the daily number of debit card payments made by consumers?"*.

Given the general consensus from the literature that media publications significantly influence consumers' confidence and behaviour, we may expect news reports on debit card fraud to depress card usage. However, given the various indications that consumers' reactions are generally found to last temporarily and to diminish in the longer run, we may expect to find consumers to soon revert back to their regular payment behaviour.

5.3 Methodology and data

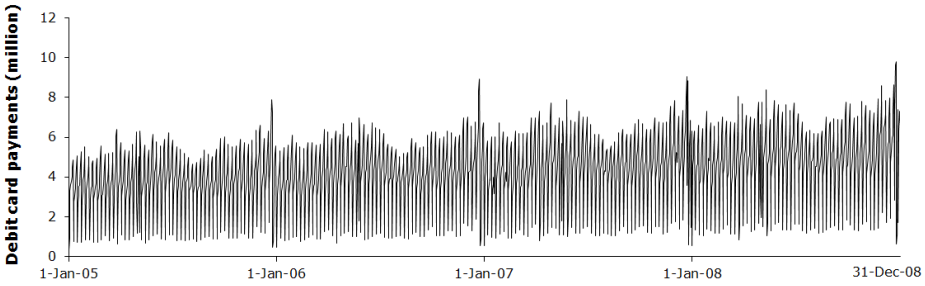
5.3.1 Data collection and key statistics

Daily debit card payments

In order to answer the main research question of this chapter, we analyse daily debit card transaction data provided by Equens, the Automated Clearing House (ACH) responsible for the processing of domestic debit card transactions in the Netherlands. The data cover all daily debit card payments made by Dutch residents at point-of-sale (POS) terminals in the Netherlands from January 1st 2005 to December 31st 2008.[2] In using daily

[2]Ideally, we would have liked to use an even longer time-series. However, at the start of this research project, more recent data on debit card payments and newspaper publications were not yet available. Moreover, the number of skimming fraud articles

Figure 5.1: Daily number of POS debit card payments in the Netherlands



Note: This figure presents the total daily number of debit card payments made by Dutch residents at ticket machines and other point-of-sale terminals in the Netherlands. Data are supplied by Equens.

national transaction records, we are able to assess *actual* payment behaviour on an *aggregate* and *high-frequency* level. Here we make an important contribution to the existing literature, as, until now, most empirical payment studies are based on either consumer survey data or on annual transaction records of banks, retailers or processors. The former type of data allow for thorough analyses of individual choices and drivers, and the latter provide a good basis for examining macro changes over time. However, the consumer survey data are mainly based on self-reported behaviour, which, as demonstrated in Chapter 2, may deviate from actual behaviour, whereas the annual transaction records do not allow for a thorough analysis of behaviour at a daily level.[3]

As depicted in Figure 5.1, the daily number of debit card payments made in the Netherlands is characterised by a positive trend and strong daily fluctuations. Overall, the number of payments is relatively high on Saturdays, in the fourth and first week of each month and in December.

published before 2005 is too small for valid statistical analyses.

[3]Ideally, one would like to combine actual high-frequency transaction records with self-reported survey data, in order to assess actual payment choices, as well as the underlying individual motivations. This may be an interesting area for future research and will therefore be further discussed in Chapter 6.

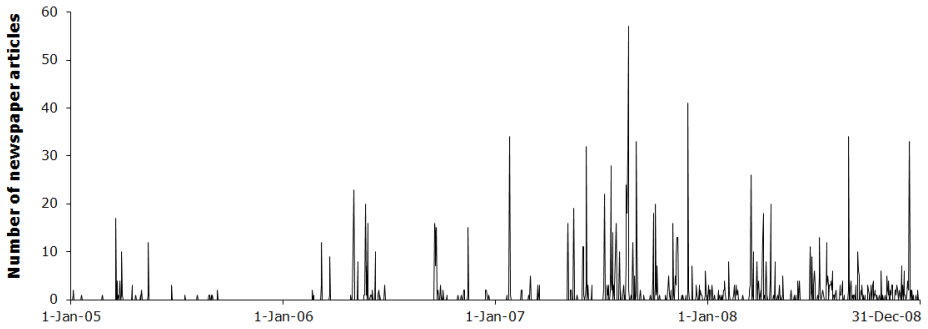
Newspaper articles about debit card skimming fraud

We used the LexisNexis database to collect newspaper articles about debit card skimming fraud. This database covers all newspaper reports published in the Netherlands in both national and regional newspapers. We performed various keyword searches to filter out the articles published between January 1st 2005 and December 31st 2008 in which somehow mention is made of debit card skimming fraud. First, we searched for articles containing the word 'skimming' or one of its synonyms, such as 'debit card fraud' or 'ATM fraud'. Second, we conducted additional searches combining the words 'debit card', 'PIN code', and 'magnetic stripe' with different fraud terms, such as 'crime', 'copy', 'victim', and 'risk'.[4] We manually checked the search results for relevance, which resulted in a final set of 1,586 articles extracted from 54 newspapers over the entire period. As a next step, for each article we recorded several characteristics, such as the type of skimming fraud addressed (e.g. skimming fraud at automated teller machines (ATMs) or skimming fraud at ticket machines and other POS terminals), and whether it was published on the front page. We did not distinguish between articles providing a negative message to the public (e.g. articles reporting about fraud incidents or articles expressing concern about the safety of card payments) and articles providing a positive message (e.g. publications about safety and compensation measures taken or publications underlining that debit cards are still safe to use). The main reason is that deciding about how newspaper articles are perceived and interpreted by the public is highly subjective, not in the least because a substantial number of articles contained more than one message (e.g. Ching et al. (2011) and Smith et al. (1988)).

Figure 5.2 displays the total daily number of newspaper articles published about debit card skimming fraud between January 1st 2005 and December 31st 2008. It shows that since January 1st 2005, and in particular from 2007 onwards, the frequency of skimming fraud publications has

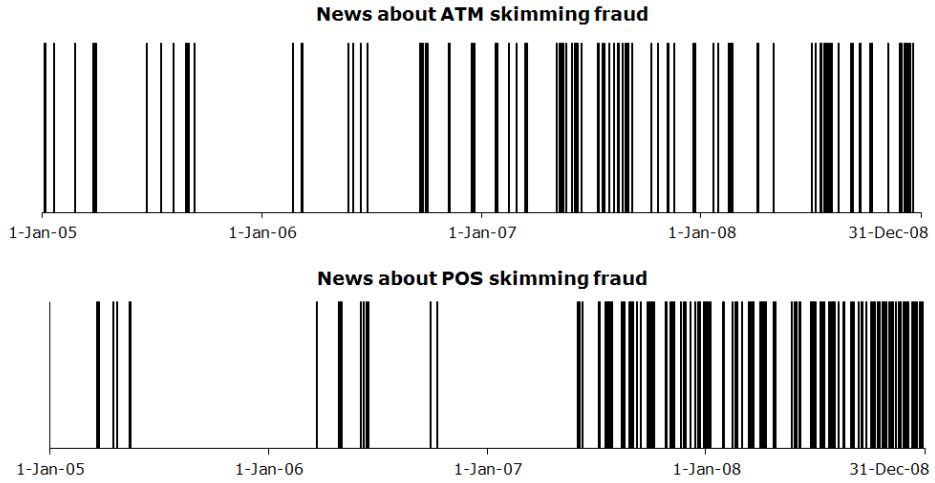
[4] An overview of all search terms used (in Dutch) is available upon request.

Figure 5.2: Daily number of newspaper articles about skimming fraud



Note: This figure presents the daily number of newspaper articles about debit card skimming fraud published in national and regional newspapers in the Netherlands. Data have been taken from LexisNexis.

Figure 5.3: Days with at least one skimming fraud publication



Note: This figure highlights the days on which at least one newspaper article was published about debit card skimming fraud. A distinction is made between articles about fraud at ATMs (upper graph) and articles about fraud at ticket machines and other points-of-sale in the Netherlands (bottom graph).

rapidly increased. As becomes apparent from Figure 5.3, this increase is mainly due to a strong growth in the number of newspaper reports about fraud at ticket machines and other POS terminals (bottom graph). Moreover, Figure 5.2 shows evidence of a strong fluctuation in the daily number of publications, with relatively high peaks around the summer of 2007.

Control variables

When analysing the impact of the newspaper publications on the daily number of debit card payments made by consumers, we will account for a large variety of calendar and moving holiday effects. The results presented in Table 2.6 in Chapter 2, for instance, demonstrate that the number of debit card payments made by Dutch consumers significantly varies over the week, with most transactions being made on Saturdays. Similarly, Rodrigues and Esteves (2010) find evidence of significant calendar and holiday effects when studying the evolution of cash withdrawals. The daily number of withdrawals is not only shown to differ per day of the week, it is also found to be higher in the first and last week of the month and during the summer holidays and the Christmas season. We follow the approach used in Rodrigues and Esteves (2010) and consider calendar effects to be anomalies related to the calendar, such as the day of the week, the month of the year and fixed holidays, such as Christmas and Queen's Day. By contrast, we define moving holidays as holidays which are not fixed on a specific date, such as Easter and Whitsun. Also, we consider pre- and post-holidays in order to account for the possibility that consumers' purchasing and payment behaviour may deviate from their regular behaviour on days prior or subsequent to particular holidays.

Another factor which may potentially affect consumers' daily shopping and, hence, their daily payment behaviour is the weather. This effect, however, has never been empirically tested. Therefore, in order to account for potential weather effects when analysing the impact of newspaper publications on daily debit card usage, we collected data on the daily rainfall and

temperature in the Netherlands from the Royal Netherlands Meteorological Institute (KNMI).

We acknowledge that there may be more factors affecting the daily fluctuations in debit card use other than calendar, holiday and weather effects, such as large-scale disruptions to the debit card system. However, since daily data are scarce, the analysis presented in this chapter limits itself to the above-mentioned control variables only.

5.3.2 Empirical model and estimation method

We use time-series regression techniques to formally assess the effects of the newspaper articles on the daily number of debit card payments. As Radwan et al. (2008) note, several types of information indices can be employed when analysing consumers' responses to news publications, ranging from dummy variables (Tansel (1993)), news counts (Smith et al. (1988)) or cumulative sums of news (e.g. van Ravenswaay and Hoehn (1991), Ching et al. (2011)). As the main purpose of this chapter is to assess the impact of daily newspaper publicity in general, and not so much to assess the marginal effects of individual articles, we follow the approach of Tansel (1993) and use a set of dummy variables ($News$) indicating on a daily basis whether any skimming fraud articles were published or not. In addition to newspaper publicity, we assume the daily number of debit card payments to be a function of a set of dummies controlling for potential calendar and holiday effects ($Calend$), as well as of the daily rainfall (in 0.1 mm) ($Rain$) and the daily temperature (in degrees Celsius) ($Temp$). Also, given the steady growth in the daily number of debit card payments over the years, we use a time trend (t), which serves as a proxy for all non-observable variables that affect debit card usage and are highly correlated with time. For instance, the time trend would capture gradually changing consumer payment habits caused by, for example, a changing population structure or increasing availability of payment terminals. For simplicity of estimation, we use a log-linear model, with the log of the daily number of debit card

payments ($logNRPOS$) being the dependent variable. Consequently, our empirical model can be summarised as follows:

$$logNRPOS = logNRPOS(News, Calend, Rain, Temp, t) \tag{5.1}$$

An important assumption underlying this model is that newspaper articles about debit card skimming fraud arrive exogenously, i.e. that they are entirely determined by factors outside the model. The justification for this assumption lies within the daily nature of the data. That is, news about debit card skimming fraud may be viewed as a reflection of actual debit card skimming fraud, which in turn may be influenced by the maturity of the debit cards market, as the 'payoffs' of committing fraud increase with the number of debit card payments made. Therefore, in the medium and long run, the intensity of news about skimming fraud may be influenced by the number of debit card payments made, and, hence, not be entirely exogenous. However, in the short run, particularly at a daily level, this potential endogeneity problem is likely to be limited. The majority of Dutch newspapers is printed in the early morning. So, the number of card payments reacts after the articles have been published, and therefore, due to the high frequency of the data, the publications can be argued not to be influenced by the movement of those payments. As a rough check of the validity of this identification argument, we had a closer look at the distribution of the newspaper articles over the different months, weeks and days. Also, we regressed the publication dummies stored in ($News$) on the various seasonal dummies captured in ($Calend$). None of the checks showed a significant seasonal pattern in the arrival of skimming fraud news, which supports the assumption that it is entirely determined outside the model.[5]

Before starting any time-series modelling, we investigated the time-series properties of the continuous variables (i.e. $logNRPOS$, $Rain$ and

[5]The capacity of high-frequency data to control for potential endogeneity and to achieve identification has been acknowledged in various research fields, such as in economics and finance and in marketing sciences (e.g. Swanson (2011), Calli, Weverbergh and Franses (2012)).

Temp) using the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test and the ADF-GLS test. They all confirm that there is a significant trend in the daily number of debit card payments (*logNRPOS*). However, they reject the null hypothesis of a unit root, even when the trend is excluded from the test equation (see Table 5.1). Also, the tests reject the null hypothesis of a unit root for *Rain* and *Temp*. This means that all variables can be assumed to be stationary, i.e. they are integrated of order zero (I(0)). Therefore, we are able to use Ordinary Least Squares (OLS) regression techniques to estimate the coefficients of Equation 5.1. Moreover, the significance of the trend in *logNRPOS* supports our decision to add a time trend to the model. Since both the Breusch-Pagan and the White test reject the null hypothesis of a constant variance, and as the Durbin's alternative test for autocorrelation points to a clear rejection of the null-hypothesis, we use heteroskedasticity-and-autocorrelation-consistent (HAC) or simply Newey-West standard errors.

First, we run a benchmark regression without any newspaper publication dummies. This regression includes a rich set of potential calendar and holiday effects including their appropriate number of lags and leads (*Calend*). As the appropriate number of lags and leads is unknown in advance, we first add two lags and two leads for each particular holiday and then econometrically test alternative combinations. Moreover, the benchmark regression includes the two weather variables *Rain* and *Temp*, and the time trend t.

In the next step, we extend the benchmark model with various newspaper publication dummies, including their lagged values so as to assess how long any newspaper effect persists. We do this in two parts. First, we add a dummy indicating on a daily basis whether any debit card skimming fraud articles were published or not, and further refine the analysis by (i) distinguishing between 'regular' articles and articles published on the front page, and by (ii) splitting the data into different periods to assess to what degree the newspaper effects (if any) have changed over time. Second, we

Table 5.1: Time-series properties of continuous variables

	Augmented Dickey-Fuller (ADF) test					Phillips-Perron (PP) test			Augmented Dickey-Fuller (ADF) GLS test	
	With trend			Without trend		With trend		Without trend	With trend	Without trend
	Order int.	Nr. lags	Trend?	Order int.	Nr. lags	Order int.	Trend?	Order int.	Order int.	Order int.
LogNRPOS	I(0)	7	Yes	I(0)	21	I(0)	Yes	I(0)	I(0)	I(0)
Rain	I(0)	1	No	I(0)	1	I(0)	No	I(0)	I(0)	I(0)
Temp	I(0)	4	No	I(0)	7	I(0)	No	I(0)	I(0)	I(0)

Note: This table summarises the time-series properties of the log of the daily number of debit card payments (*logNRPOS*), the daily rainfall (*Rain*) and the daily temperature (*Temp*) using different test specifications. For each specification, the orders of integration (Order int.) are presented, as well as the number of significant lags found (Nr. lags) and whether the trend was significant (Trend?).

take a closer look at the specific nature of the skimming fraud articles by distinguishing between (i) articles about skimming fraud at ticket machines and other POSs, and (ii) articles about skimming fraud at ATMs. The results of the benchmark model and the first extension are presented and discussed in Section 5.4.1, whereas Section 5.4.2 reports the results of the latter analysis.

5.4 Results

5.4.1 The effect of newspaper publications on card usage

Table 5.2 shows the OLS parameter estimates and the Newey-West standard errors (in italics) for the benchmark model. The coefficients can be interpreted as the percentage changes in the log of the daily number of debit card payments relative to the number of debit card payments made on the reference day, i.e. a non-holiday Sunday in the first week of January.[6] Regarding the calendar effects, there are a number of intuitive results that point to strong day, week and month effects. On Mondays, the number of card payments is more than twice as high as on Sundays, and it further increases as the week progresses. Moreover, it is highest in the first and last week of the month (when most salaries are paid out), and lowest in February (the shortest month of the year). From March onwards, the number of debit card payments increases until July, when the summer holidays start. From September onwards, it rises again, reaching its peak in December. Regarding the fixed and moving holidays, the findings are also as expected. In general, the number of card payments is higher on days prior to a particular holiday, whereas the holidays themselves are characterised by a strong decrease in card use. Concerning post-holidays, we find strong negative effects for the days after Easter Day, Whitsun Day and Christmas Day. This is not surprising as these days are celebrated as national work-

[6] In order to draw conclusions about the impact of the explanatory variables on the daily number of debit card payments in levels, the regression coefficients are to be exponentiated.

Table 5.2: Daily debit card usage: the role of calendar, holiday, weather and trend effects

Calendar, weather & trend effects		Fixed holiday effects		Moving holiday effects	
Day of the week:		Valentines Day:		Mother's Day:	
Monday	1.131^{***}	$\text{Valentine}_{t=0}$	0.065^{***}	Mother's_{t-2}	0.055^{***}
	0.020		*0.005*		*0.010*
Tuesday	1.231^{***}			Mother's_{t-1}	0.100^{***}
	0.025	Queen's Day:			*0.012*
Wednesday	1.332^{***}	Queen's_{t-4}	0.055^{***}	$\text{Mother's}_{t=0}$	-0.078^{***}
	0.023		*0.013*		*0.025*
Thursday	1.386^{***}	Queen's_{t-3}	0.105^{***}		
	0.027		*0.017*	Father's Day:	
Friday	1.574^{***}	Queen's_{t-2}	0.111^{***}	Father's_{t-6}	0.031^{**}
	0.028		*0.007*		*0.015*
Saturday	1.668^{***}	Queen's_{t-1}	0.185^{***}	Father's_{t-5}	0.034^{***}
	0.027		*0.027*		*0.007*
		$\text{Queen's}_{t=0}$	-0.679^{***}	Father's_{t-4}	0.058^{***}
Week of the month:			*0.030*		*0.009*
Week2	-0.065^{***}			Father's_{t-3}	0.071^{***}
	0.002	St. Nicolas Day:			*0.010*
Week3	-0.054^{***}	St. Nicolas_{t-2}	0.076^{*}	Father's_{t-2}	0.045^{***}
	0.003		*0.040*		*0.012*
Week4	0.027^{***}	St. Nicolas_{t-1}	0.034^{***}	Father's_{t-1}	0.087^{***}
	0.004		*0.007*		*0.016*
		$\text{St. Nicolas}_{t=0}$	-0.063^{***}	$\text{Father's}_{t=0}$	-0.108^{***}
Month of the year:			*0.011*		*0.026*
February	-0.003	St. Nicolas_{t+1}	-0.141^{***}		
	0.006		*0.019*	Easter Day:	
March	0.035^{***}			Easter_{t-4}	0.047^{***}
	0.007	Christmas Day:			*0.003*
April	0.080^{***}	Christmas_{t-6}	0.070^{***}	Easter_{t-3}	0.123^{***}
	0.012		*0.019*		*0.017*
May	0.101^{***}	Christmas_{t-5}	0.128^{***}	Easter_{t-2}	0.161^{***}
	0.011		*0.023*		*0.023*
June	0.112^{***}	Christmas_{t-4}	0.322^{***}	Easter_{t-1}	0.123^{***}
	0.010		*0.087*		*0.018*
July	0.051^{***}	Christmas_{t-3}	0.242^{***}	$\text{Easter}_{t=0}$	-0.451^{***}
	0.013		*0.046*		*0.027*
August	0.007	Christmas_{t-2}	0.471^{***}	Easter_{t+1}	-0.870^{***}
	0.013		*0.125*		*0.021*
September	0.038^{***}	Christmas_{t-1}	0.453^{***}		
	0.013		*0.107*	Ascension Day:	
October	0.058^{***}	$\text{Christmas}_{t=0}$	-1.885^{***}	Ascension_{t-2}	0.063^{**}
	0.009		*0.291*		*0.029*
November	0.080^{***}	Christmas_{t+1}	-1.683^{***}	Ascension_{t-1}	0.208^{***}
	0.007		*0.036*		*0.014*
December	0.164^{***}			$\text{Ascension}_{t=0}$	-1.078^{***}
	0.006	New Year:			*0.058*
		$\text{New year}_{t=0}$	-1.580^{***}	Ascension_{t+1}	0.153^{***}
Weather:			*0.318*		*0.011*
Rain	-0.0002^{***}			Ascension_{t+2}	-0.092^{***}
	0.0000				*0.015*
Temperature	0.0000				
	0.0000			Whitsun:	
				Whitsun_{t-2}	0.031^{**}
					0.013
Other:				Whitsun_{t-1}	0.070^{***}
Trend	0.0003^{***}				*0.020*
	0.0000			$\text{Whitsun}_{t=0}$	-0.307^{***}
Constant	13.7452^{***}				*0.031*
	0.0207			Whitsun_{t+1}	-0.823^{***}
					0.027
No. Observations	1,453	R-squared	0.9810	Adj. R-squared	0.9801

Note: OLS parameter estimates and Newey-West Standard Errors (in italics). The dependent variable is the total number of daily debit card payments in the Netherlands (in logs). The calendar and holiday effects should be interpreted as the percentage changes relative to a non-holiday Sunday of the first week of January. Various combinations of lag and lead lengths have been investigated using separate t-tests and joint F-tests. This table only presents the results of those that turned out to have a significant effect. ***/**/* denotes significance at the 1%/5%/10% level respectively.

free holidays too. The results further confirm a significant weather effect. The total number of debit card payments decreases with the amount of rainfall. This most probably reflects that on rainy days consumers rather stay at home and, hence, make fewer transactions at all. Moreover, the positive coefficient for temperature suggests that debit card use increases with the daily temperature. However, the effect is not significant. Finally, the strong significance of the time trend shows that the number of debit card payments significantly increases over time due to variables other than those included in the model. For instance, it may reflect that consumers' payment preferences gradually change and that debit cards are increasingly accepted at the POS. On average, total debit card payments increases by 0.03% a day, holding all other variables fixed.[7]

Turning to the effect of debit card skimming fraud news, Table 5.3 presents the OLS coefficients of the various newspaper publication dummies added to the benchmark model. First of all, the results in Column 1 show that newspaper articles about debit card skimming fraud depressed same day debit card use between the beginning of January 2005 and the end of December 2008. On average, the total number of debit card payments was 0.8% lower on days when skimming fraud articles were published than what it would have been without these publications. In accordance with the related literature, the insignificance of all tested lagged values indicates that the news effects only lasted for one day with consumers reverting back to their regular payment behaviour almost immediately.[8] When extending the model with a 'front page' dummy for days on which articles were published on the front page (Column 2), there is an indication of an additional depressing effect of 0.5%.[9] The effect, though, is not significant.

[7] This corresponds to the actual debit card figures of Currence showing a total debit card transaction growth of 40% and an average yearly growth of 10% between the beginning of 2005 and the end of 2008.

[8] Alternative combinations of lag lengths have been investigated using separate t-tests and joint F-tests. They all turned out to be insignificant.

[9] The coefficients of the 'front page' dummies should be interpreted as percentage changes relative to the effects of 'non-front page' news.

Table 5.3: Daily debit card usage: the role of newspaper publications

	(1)		(2)		(3)		(4)	
	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors
News on skimming fraud$_{t=0}$	-0.008^{*}	0.005						
News on skimming fraud$_{t-1}$	-0.000	0.005						
News on skimming fraud:								
Non-front page news$_{t=0}$			-0.008^{*}	0.005				
Non-front page news$_{t-1}$			-0.001	0.006				
Front page news$_{t=0}$			-0.005	0.014				
Front page news$_{t-1}$			0.004	0.011				
Non-front page news:								
Before mid 2007$_{t=0}$					0.006	0.006		
Before mid 2007$_{t-1}$					-0.002	0.011		
After mid 2007$_{t=0}$					-0.024^{***}	0.008		
After mid 2007$_{t-1}$					0.001	0.012		
Front page news:								
Before mid 2007$_{t=0}$					0.017	0.017		
Before mid 2007$_{t-1}$					0.015	0.022		
After mid 2007$_{t=0}$					-0.032	0.024		
After mid 2007$_{t-1}$					-0.016	0.026		
Non-front page news:								
Jan. 05 - Jul. 07$_{t=0}$							0.007	0.006
Jan. 05 - Jul. 07$_{t-1}$							-0.001	0.011
Jul. 07 - Jan. 08$_{t=0}$							-0.028^{***}	0.009
Jul. 07 - Jan. 08$_{t-1}$							-0.011	0.013
Jan. 08 - Jul. 08$_{t=0}$							-0.014^{**}	0.007
Jan. 08 - Jul. 08$_{t-1}$							0.009	0.012
Jul. 08 - Dec. 08$_{t=0}$							-0.026^{**}	0.011
Jul. 08 - Dec. 08$_{t-1}$							0.004	0.011
Front page news:								
Jan. 05 - Jul. 07$_{t=0}$							0.016	0.018
Jan. 05 - Jul. 07$_{t-1}$							0.014	0.023
Jul. 07 - Jan. 08$_{t=0}$							0.025	0.019
Jul. 07 - Jan. 08$_{t-1}$							0.010	0.022
Jan. 08 - Jul. 08$_{t=0}$							-0.014	0.020
Jan. 08 - Jul. 08$_{t-1}$							0.017	0.024
Jul. 08 - Dec. 08$_{t=0}$							-0.054^{***}	0.021
Jul. 08 - Dec. 08$_{t-1}$							-0.032	0.023
R-squared		0.9811		0.9811		0.9812		0.9813
Adj. R-squared		0.9801		0.9801		0.9802		0.9802

Note: OLS parameter estimates and Newey-West Standard Errors. The results are based on 1,453 observations. The dependent variable is the total number of daily debit card payments in the Netherlands in logs. To assess the impact on the daily number of payments in levels, the coefficients are to be exponentiated. The regressions include the full set of control variables presented in Table 5.2. The effects of 'front page' articles and articles published in the various periods after mid-2007 should be interpreted as percentage changes relative to the effects of 'non-front page' news and articles published before mid-2007. ***/**/* denotes significance at the 1%/5%/10% level respectively.

The models presented in Columns 1 and 2 assume a constant newspaper effect over the entire research period. This may, however, not be appropriate given the strong increase in skimming fraud news over the years, due to which consumers may have changed their awareness, attitudes and behaviour. Therefore, in order to assess whether consumers' reactions have changed over time, we created separate dummy variables for newspaper articles published after mid-2007. There are various reasons for using this particular structural breakpoint. First, as demonstrated in Figure 5.2 and Figure 5.3, the frequency of skimming fraud publications has rapidly increased since mid-2007. Moreover, before mid-2007, the newspapers mainly reported about skimming fraud at ATMs, whereas after mid-2007, they increasingly contained news about POS skimming fraud as well. The estimation results presented in Column 3 indeed provide evidence of a significant structural break around mid-2007.[10] Its insignificant parameter shows that up to July 2007, newspaper articles about skimming fraud had no effect on the daily number of debit card payments made. For the period after July 2007, however, we find a significant negative effect of 2.4%. Regarding any additional front page effect, again, no significant differences are found. A further break down of the period after July 2007, though, seems to be useful (Column 4).[11] Overall, the final model demonstrates that consumers' reactions grew stronger in the periods when more articles were published and that they weakened again as soon as the media attention lessened. That is, before mid-2007, the newspaper articles are shown to have had no effect at all. However, they did depress the daily number of debit card payments with 2.8% in the second half of 2007 when the newspapers were full of skimming fraud articles. Subsequently, the news effects decreased to -1.4% between January 2008 and July 2008, but they grew stronger again to -2.6% in the second half of 2008, which was characterised by a new wave

[10] The coefficients of the articles published after mid-2007 should be interpreted as percentage changes relative to the effects of those published before mid-2007.

[11] The coefficients reported for the various periods after mid-2007 should be interpreted as percentage changes relative to the effects of articles published before mid-2007.

of POS fraud announcements. Also, the results in Column 4 now point to a clear additional front page effect of -5.3% for the second half of 2008. This suggests that during this period, the total number of debit card payments was 7.9% lower on days when newspaper articles were published on the front page of a Dutch newspaper than what it would have been without any publications. In all cases, again, all lagged publication dummies turned out to be insignificant, suggesting that the news effects only lasted for one day.

5.4.2 Additional analyses

Overall, the results presented in Table 5.3 suggest that newspaper publications about debit card skimming fraud have a depressing effect on debit card usage. The strength of the newspaper effects, however, fluctuates over time, with consumers' reactions being stronger in periods when more articles are published. Table 5.4 further expands the analysis by looking at the specific content of the publications by breaking them down by type of skimming fraud addressed. Column 2 presents some first indications that consumers reacted differently to articles about skimming fraud at POSs than to articles about fraud at ATMs. The findings suggest that the total number of debit card payments decreased by 1.4% on days when POS fraud articles were published, whereas, though insignificant, for ATM fraud articles a positive effect is reported. However, again, allowing the newspaper effects to change over time appears to be relevant. Column 4 shows that POS skimming fraud articles have only started to affect consumers' payment behaviour since January 2008.[12] On average, in 2008, the daily number of debit card payments was 2.7% lower on days when articles were published about POS fraud than what it would have been without these publications. By contrast, newspaper articles about ATM fraud are found to have affected debit card usage already from 2005 onwards. Interestingly,

[12]The coefficients reported for the various periods after mid-2007 should be interpreted as percentage changes relative to the effects of articles published before mid-2007.

Table 5.4: The role of newspaper publications by type of skimming fraud addressed

	(1)		(2)		(3)		(4)	
	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors	OLS estimates	Newey-West St. Errors
News on skimming fraud$_{t=0}$	-0.008^{*}	0.005						
News on skimming fraud$_{t-1}$	-0.000	0.005						
News on skimming fraud:								
POS fraud$_{t=0}$			-0.014^{***}	0.005				
POS fraudt$_{t-1}$			0.002	0.006				
ATM fraud$_{t=0}$			0.008	0.008				
ATM fraud$_{t-1}$			0.011	0.008				
News on POS skimming fraud:								
Before mid 2007$_{t=0}$					0.005	0.010		
Before mid 2007$_{t-1}$					-0.012	0.014		
After mid 2007$_{t=0}$					-0.021^{*}	0.012		
After mid 2007$_{t-1}$					0.017	0.017		
News on ATM skimming fraud:								
Before mid 2007$_{t=0}$					0.016^{***}	0.005		
Before mid 2007$_{t-1}$					0.009	0.013		
After mid 2007$_{t=0}$					-0.032^{***}	0.011		
After mid 2007$_{t-1}$					0.002	0.018		
News on POS skimming fraud:								
Jan. 05 - Jul. 07$_{t=0}$							0.005	0.010
Jan. 05 - Jul. 07$_{t-1}$							-0.011	0.014
Jul. 07 - Jan. 08$_{t=0}$							-0.012	0.010
Jul. 07 - Jan. 08$_{t-1}$							-0.000	0.023
Jan. 08 - Jul. 08$_{t=0}$							-0.026^{***}	0.010
Jan. 08 - Jul. 08$_{t-1}$							0.035	0.014
Jul. 08 - Dec. 08$_{t=0}$							-0.027^{**}	0.011
Jul. 08 - Dec. 08$_{t-1}$							0.016	0.016
News on ATM skimming fraud:								
Jan. 05 - Jul. 07$_{t=0}$							0.016^{***}	0.005
Jan. 05 - Jul. 07$_{t-1}$							0.010	0.013
Jul. 07 - Jan. 08$_{t=0}$							-0.027^{**}	0.012
Jul. 07 - Jan. 08$_{t-1}$							-0.000	0.022
Jan. 08 - Jul. 08$_{t=0}$							-0.012	0.008
Jan. 08 - Jul. 08$_{t-1}$							0.009	0.020
Jul. 08 - Dec. 08$_{t=0}$							-0.044^{***}	0.006
Jul. 08 - Dec. 08$_{t-1}$							-0.032	0.004
R-squared		0.9811		0.9811		0.9812		0.9813
Adj. R-squared		0.9801		0.9801		0.9802		0.9802

Note: OLS parameter estimates and Newey-West Standard Errors. The results are based on 1,453 observations. The dependent variable is the total number of daily debit card payments in the Netherlands in logs. To assess the impact of the explanatory variables on the daily number of payments in levels, the coefficients are to be exponentiated. The regressions include the full set of control variables presented in Table 5.2. The effects of articles published in the various periods after mid-2007 should be interpreted as percentage changes relative to the effects of those published before mid-2007. ***/**/* denotes significance at the 1%/5%/10% level respectively.

the magnitude of the effect of ATM fraud news has changed over time. Initially, it had a significant positive effect on debit card usage, with the total number of debit card payments being 1.6% higher on days with ATM fraud publications. This may potentially indicate that paying by debit card was perceived as a safer alternative to withdrawing cash from an ATM. The significant and growing negative parameters for the periods after July 2007, however, show that over the course of time, the positive effect has gradually turned into a negative effect. This may indicate that the strong increase in newspaper publications after mid-2007, and in particular the growing attention for POS skimming fraud, has increased consumers' awareness of debit card skimming fraud and changed their attitudes towards the debit card, with no longer making a difference anymore between using it for withdrawing cash and using it for making payments. In none of the regressions, the lagged publication dummies turned out to be significant. This suggests, again, that the newspaper effects only lasted for one day.

To summarise, we find that newspaper articles about debit card skimming fraud significantly affect debit card usage. The direction and strength of the effects, however, vary with the specific features of the publications, such as the type of fraud addressed, their position in the newspaper, and the frequency with which they come out. Yet, in all cases the news effects are relatively small and short-lived. Although this is in line with the conclusions drawn in other fields of research, additional analyses may be useful to further assess the strength and duration of the effects. In particular, consumers' reactions may differ depending on the duration of the media attention. That is, newspapers may report about fraud incidents for several days in a row. This prolonged news exposure may lead to different reactions compared to so-called 'one-off' reports. For example, consumers may strengthen and extend their reactions after periods of continuous publications. The results presented in Columns 4 in Table 5.3 and Table 5.4 indeed show that consumers' reactions were stronger in periods when more articles were published and thus point to a certain cumulative effect. In

order to further explore this, we did some additional analyses to assess whether the effects indeed increase or last longer after periods of continuous publications. We created dummy variables, which took on a value of one on days when fraud articles were published on both the respective and the past X number of days, and zero otherwise, with X varying from one to five days.[13] Subsequently, we added these dummies to the benchmark model. In all cases, the results did not point to any significant cumulative effects. Also, the 'one-off' publications turned out to no longer affect debit card usage. The main explanation most probably lies within the limited number of observations for each dummy variable. Hence, with a longer time-series we would be better equipped to further explore these results. Therefore, as will be further discussed in Chapter 6, future research would be valuable.

5.5 Conclusions

In this chapter, we investigated the impact of newspaper articles about debit card skimming fraud on the daily number of debit card payments made in the Netherlands. We analysed a rich set of daily debit card transaction records and daily newspaper announcements from January 1st 2005 to December 31st 2008 using time-series regression techniques. Our key finding is that news about debit card skimming fraud significantly affects debit card use. Overall, the total number of debit card payments significantly drops on days when newspapers report about skimming fraud. This finding is robust to controlling for a wide variety of calendar, holiday, weather and trend effects, and confirms the conclusions from the general literature on media publications and consumer behaviour. The exact direction and strength of the news effects, however, vary with the specific characteristics

[13] Of all POS skimming fraud articles in our dataset, 58% were 'one-off' publications, i.e. no fraud reports were published on the day before. The other 42% came out on days when other articles had been published on the day(s) before as well. Similarly, 68% of all ATM fraud articles concerned 'one-off' publications.

of the publications, such as the type of skimming fraud addressed and their position in the newspaper. For example, we present evidence that initially consumers reacted differently to articles about skimming fraud at ATMs than they did to articles about fraud at POS terminals. This difference, however, disappeared over the years. Also, we find that newspaper articles have a stronger effect when they are placed on the front page than elsewhere in the paper. Moreover, we show that the reduction in debit card use is strongest in periods when more debit card fraud articles are published, and that it weakens again as soon as the media attention lessens. Yet, we can conclude that, though statistically significant, the newspaper effects are economically small compared to other factors, such as calender, holiday and trend effects. In addition, the news effects only last for one day, with consumers reverting back to their regular payment behaviour almost immediately. Although the relatively small and short-lived effects of public information have also been established elsewhere in the literature, future research is to be recommended to further assess what drives this finding.

Despite their relatively small and short-lived nature, the significance of the newspaper effects and the fact that they grow stronger in periods with intensive media attention provide a meaningful policy message. It shows that safety and fraud incidents may not only through personal experiences, but also through the media, pose a barrier to a further growth in the use of electronic payment instruments. In particular when there is extensive and long-term media coverage. Moreover, it demonstrates that safety and fraud incidents have potential to affect the overall social cost efficiency of a payment system when inducing a shift towards means of payment that carry a higher cost to society. As discussed in Chapter 4, this underlines the need for effective safety measures, as well as for clear public communication about actual levels of safety. However, the short-lived effect of newspaper articles suggests that this will require a well-considered and long-term communication plan.

Chapter 6

Conclusions

This final chapter provides a concise overview of the main results presented in the four previous chapters, followed by a discussion of their policy implications in view of the thesis' main objective and research question. Finally, this chapter proposes various directions for future research.

'Discovery consists of seeing what everybody has seen and thinking what nobody has thought'
Albert Szent-Györgyi (1893 - 1986)

6.1 Synopsis

There is a large variety of instruments that consumers can use for making payments, such as cash and cards for daily purchases, paper forms, direct debits and online transfers for bill payments, and digital money and online banking applications for payment of online purchases. Overall, over the past decades, the use of these payment instruments has considerably changed. Due to technological advancements and changing payment needs, there has been a global trend towards paying electronically, for instance using payment cards, online transfers or digital money. Yet, consumers still heavily rely on cash and other paper-based instruments. In general, paying with cash, cheques and other paper-based solutions is more costly to society than paying electronically. Hence, a further shift towards electronics may reduce the overall social costs of a payment system.

Given this background, the objective of this thesis was to examine the drivers and mechanisms underlying consumers' choice of which payment instruments to use, focusing on the choice between instruments when paying in shops, at vending machines and at other points-of-sale (POS). By studying this so-called POS payment choice, this thesis aimed to shed light on the question of whether and how the use of electronic payment instruments can be further increased, i.e. whether there is room for further digitisation. We focussed on two research topics: the role of consumers' foreign background, and the role of payments fraud and safety risks. More specifically, the main research question was *"How are consumer payment choices influenced by foreign backgrounds and payments safety?"* However, having accurate information about the individual payment choices made is crucial for examining the drivers underneath. Unfortunately, due to their anonymous

nature, actual data on the number and characteristics of cash payments are lacking. Consequently, a common approach for collecting detailed information about the use of cash is to survey consumers. This, however, asks for a sound methodology, as consumer surveys are typically sensitive to errors that may affect the final outcomes. Therefore, given the importance of having reliable survey estimates, this thesis starts with empirically investigating what is the best survey methodology to measure the number of cash payments made by consumers. Hence, in Chapter 2 we designed, conducted and assessed seven separate surveys, each one using a different method. Each survey method differed from the others in terms of survey length (i.e. one-day vs. one-week), data collection mode (i.e. respondents answering a retrospective recall questionnaire vs. respondents documenting their payments in a so-called payment diary) or sampling frame (i.e. telephone vs. online panel). Asking consumers to register their purchases in a payment diary for one single day, i.e. a one-day payment diary, turned out to be best suited to estimate consumers' use of cash. Therefore, this survey method was subsequently used in Chapter 3. There we turned to answering the thesis' main research question by studying whether the payment choices made by consumers having a foreign background are in any way different from those of the native population. Also, we assessed to what degree the payment choices of persons having a background abroad are correlated with the payment habits in their home countries and whether they differ between generations. The two consecutive chapters focussed on the effects of safety and payments fraud. More specifically, Chapter 4 investigated how consumers assess the safety of payment instruments and how this affects their choices between cash and debit cards, whereas Chapter 5 examined whether consumers change their payment behaviour after reading about card fraud in the newspaper. Tables 6.1 and 6.2 present an overview of the main research questions and key findings of each of the four chapters.

Table 6.1: Overview of key findings of Chapter 2 and Chapter 3

	Chapter 2	**Chapter 3**
Title:	Measuring payment choices: the impact of survey design on cash estimates	Role of foreign background in consumer payment choice
Underlying work:	Jonker and Kosse (2013)	Kosse and Jansen (2013)
Research question:	What is the best way to measure the number of cash payments made by consumers?	Do POS payment choices of consumers differ according to their country of origin and generation, and to what extent are these choices influenced by home-country habits?
Key findings:		
1.	Consumer surveys are suitable techniques for collecting accurate data on cash use, but survey method and survey length significantly affect the estimates.	Foreign backgrounds do influence consumers' payment choices after migration.
2.	Retrospective recall questionnaires are likely to underestimate low value cash payments due to incomplete recall errors.	First-generation migrants from non-western countries are more likely to use cash than the native Dutch.
3.	One-week payment diaries are vulnerable to underestimation of low value cash payments too, due to diary fatigue and diary despair. Also when using interim reminders.	Migrants having a background in various cash-oriented countries are more likely to pay by cash than those born in the Netherlands.
4.	Therefore, one-day payment diaries are to be preferred for the collection of reliable cash data.	The number of card payments per capita in a person's home country is negatively related to the likelihood of using cash after migration.
5.	No evidence is found of selection biases when using an online instead of a telephone panel.	Differences in payment behaviour are only present for the first-generation: second-generation migrants have similar payment habits as individuals with a Dutch background.

Table 6.2: Overview of key findings of Chapter 4 and Chapter 5

	Chapter 4	**Chapter 5**
Title:	The safety of paying: consumer perceptions and payment choices	Do newspaper articles on card fraud affect card usage?
Underlying work:	Kosse (2013b)	Kosse (2013a)
Research question:	What are the determinants of consumers' views on the safety of payment instruments, and to what extent is the use of cash and debit cards influenced by their levels of safety as perceived by the consumer?	What is the impact of newspaper articles about debit card skimming fraud on the daily number of debit card payments made by consumers?
Key findings:		
1.	The degree to which consumers assess POS payment instruments as safe is mainly determined by their perception of the probability of incidents occurring.	News about debit card skimming fraud significantly affects debit card use.
2.	Consumers do consider the severity of the potential consequences of incidents as well, though to a much lesser degree.	Overall, debit card use drops on days when newspapers report about skimming fraud.
3.	Consumers' views on the probability and severity of payment incidents vary with personal characteristics and past experiences.	Newspaper articles have a stronger effect when they are placed on the front page than elsewhere in the paper.
4.	The use of cash and debit cards is significantly influenced by consumers' perceptions of safety: consumers are less likely to pay by cash or debit card when they perceive it as unsafe.	The reduction in card use is strongest in periods when more articles are published and weakens again when the media attention lessens.
5.		Though statistically significant, the newspaper effects are economically small and only last for one day.

6.2 Discussion and policy implications

6.2.1 Measuring consumer payment behaviour

Having accurate data on the use of payment instruments is key to assessing the drivers and barriers underneath, and, hence, for taking appropriate measures to foster the use of the most socially cost efficient payment instruments. That is, one can only study and steer consumers' payment choices, when knowing what the actual choices are. Whereas non-cash payments are usually recorded by banks and/or payment processors, cash payments are characterised by their anonymous nature and therefore not centrally registered. As a result, actual records on the total number and features of consumers' cash payments are lacking. Therefore, the most common way to fill this gap is to use representative surveys asking consumers about their payment behaviour. However, these so-called payment surveys require a sound survey methodology, as surveys are typically sensitive to errors that may affect the research outcomes. In light of this, by studying in Chapter 2 what survey method is best suited to measure the use of cash by consumers, this thesis adds to the existing literature in that it provides insight into the various types of errors that may arise in payment surveys. Moreover, it demonstrates that the best way to measure consumers' payment choices, and in particular their use of cash, is to ask consumers to register their daily purchases in a payment diary, as retrospective recall questionnaires are vulnerable to underestimation of, in particular, low value cash payments. The length of the diary period, however, has to be short. We concluded that payment diaries that need to be kept for one single day, i.e. one-day diaries, are to be preferred over one-week diaries, as the latter ones are sensitive to underestimation of low value cash payments too, due to diary fatigue and diary despair, i.e. gradual or immediate loss of commitment and accuracy because of participating for multiple days. Herewith our results confirm the general conclusion from the literature that recall questionnaires and multiple-day diaries may suffer from incomplete recall of, in particular,

non-salient events. Finally, as opposed to earlier papers, we did not find evidence of selection biases when selecting respondents from an online instead of a telephone panel.

Knowing how to best measure the use of cash in terms of transactions is of great importance to central banks, commercial banks, businesses and other participants in the retail payments chain who strive for further stimulating socially cost efficient payment choices. In particular, as cash is still heavily used for the smallest transactions, having accurate insight into the number and characteristics of low value payments is essential, as it allows for a better understanding of consumers' motivations for using cash, thereby offering trustworthy input for a constructive policy debate on which policy measures to take for further fostering the use of electronic means of payment. Moreover, reliable data on the use of cash at such a detailed level are essential to monitoring how payment habits evolve over time and to measuring the total costs of cash payments. Incorrect data on the number and value of cash payments may lead to incorrect conclusions on the relative importance and the relative costs of cash to society. In that case, inappropriate inferences may be made on which payment instruments to stimulate for improving the social cost efficiency of the payment system.

Apart from measuring cash payments in the Netherlands, our findings may have wider applicability. The conclusion that one-day diaries are to be preferred corresponds to the earlier literature showing evidence of multiple-day diaries and recall questionnaires suffering from diary fatigue, diary despair and significant underreporting of non-salient events. Therefore, the findings may be expected to apply to other countries too. The finding that respondents from online panels do not behave differently than people from a telephone panel, however, may not necessarily have wider applicability, as the Netherlands is characterised by a relatively high level of internet access. At the time of the survey, around 90% of Dutch households had internet access, which was relatively high compared to the European average

of 65%.[1] Therefore, similar studies conducted in countries with a low(er) internet penetration may still suffer from biases due to online panel respondents being more 'electronically-minded' than the average population.

Second, given the resemblance of our findings to the existing literature, one-day payment diaries may also be expected to be useful for measuring other types of payments for which actual data are difficult to obtain. Over the past decade, various new payment instruments have been introduced, such as contactless prepaid cards in public transport systems or prepaid card solutions for paying in shops (CPSS (2012)). Moreover, there has been a proliferation of communities on the internet, some of which have created and circulated their own virtual currency. Usually, these currencies allow for purchasing goods and services within the specific community (e.g. Second Life's Linden Dollars), but some may also be used in the real world, such as Bitcoins (see ECB (2012)). Due to their electronic nature, these innovative payments are in some way recorded by the respective providers. Yet, collecting these records in order to get a complete picture of all payments made within a society may be difficult. That is, a large share of these innovative payments are offered by new non-bank providers that often process their payments outside the traditional payment system. As a result, these payments may not automatically be included in the aggregated transaction records of banks or payment processors. And as new non-bank providers are not always subject to existing payment statistics reporting requirements (CPSS (2012)), they may not be willing to share their data. Therefore, like cash, actual data on the use of innovative payment options may be difficult to obtain. Nevertheless, having insight into the use of these new payment instruments is important from a policy perspective, as it helps in monitoring and understanding the latest trends in retail payments, including the underlying drivers and potential social consequences. Hence, one-day payment diaries may prove useful here as well. In particular because many innovations target the market for especially low value

[1] Eurostat Statistics, 2009, available at www.eurostat.ec.europa.eu.

payments, which, according to our findings, are likely to be underestimated when using retrospective recall questionnaires or one-week diaries.

Finally, apart from payments research, the conclusions of Chapter 2 provide meaningful messages for other research fields too. We showed that the quality of measuring frequent and small events improves when using self-reported diaries and when shortening the survey period. These conclusions may be useful for other fields of research that also aim at measuring and estimating events or decisions that are easily forgotten. Consumer expenditure and marketing surveys, for instance, often suffer from an underestimation of total expenditures. Especially information on small expenses appears to be difficult. The underestimations are often corrected for using various modelling and prediction techniques (e.g. Alessie et al. (1990), van Praag and Vermeulen (1993), Gibson and Kim (2007)). However, this thesis demonstrates that these kind of surveys may also benefit from improved survey design, i.e. by using self-reported diaries for a period of one day.

6.2.2 Role of consumers' foreign background

This thesis further contributes to the literature by providing insight into whether the choices between payment instruments made by individuals with a foreign background are in any way different than those of the native population, and if so, into what extent these differences can be explained by the payment habits in their countries of origin. Given the significant importance of people having a foreign background in many countries, having insight into their payment choices and the underlying reasons is relevant for answering the question of whether and how the use of electronic payment instruments can be further stimulated in order to foster the overall social cost efficiency of the payment system.

The results of Chapter 3 demonstrated that foreign backgrounds do influence consumers' choice between cash and debit card after migration. We showed that consumers from non-western countries and from countries that are characterised by high levels of cash use are more inclined to use cash

after migration as well. Yet, these home-country effects only influence the behaviour of migrants born and raised abroad. For the second generation we found no behavioural differences compared to the native population. Herewith our findings correspond to the literature in other research fields, which also shows the importance of home-country culture, as well as of convergence of the second generation towards the culture in the host country.

Chapter 3 offers valuable policy implications related to the question of whether there is room for a further increase in the use of electronic payment instruments. First, the results point to relatively high levels of cash use among migrants originating from cash-oriented economies. This suggests that there is still room for further digitisation. However, these strong cash preferences are only present for the first generation. This implies that the possibilities to stimulate electronic ways of paying strongly depend on the size of this particular group. This size may either increase or decrease over time depending on the extent to which new migrants are entering the country. Second, the finding that differences in payment preferences are no longer present for the second generation provides an interesting policy message. It not only suggests that the diverging payment habits among the first generation are not passed on, it also implies that they are not caused by generic migrant-related barriers that ask for policy interventions. Instead, it shows that the payment choices of first-generation migrants are mainly driven by home-country habits, i.e. habits formed in the country where they have grown up.

Against this background, an interesting policy question is whether there is a case for targeted information campaigns to stimulate the use of electronic payment instruments among this specific population group. First, given the important role of habits, such a campaign would presumably be costly and long-term in order to engineer a substantial behavioural shift. Second, as noted in Section 3.3.1, ethnic minorities are generally difficult to approach. This, again, would imply high investment costs. Finally, it needs to be considered how much substitution may be realised. In all likelihood,

it will only affect the habits of a fraction of the targeted population.

A stylised analysis is useful to put the potential social benefits of such a campaign into perspective. Let us take the Netherlands as an example, where the total social costs of paying are found to be reduced when substituting cash by debit card payments (e.g. Brits and Winder (2005), Jonker (2013)). So, would it be worthwhile to develop targeted programs for first-generation migrants from cash-oriented economies to foster the use of debit cards in the Netherlands? Let us suppose the most optimistic scenario in which a campaign is fully successful in reducing the cash ratio of the around 500.000 first-generation migrants from cash-oriented economies from 74% to the cash ratio of the other migrant groups (i.e. 66%, see survey results presented in Chapter 3, Table 3.4). Assuming that the total number of payments made by this former group (i.e. 2.44 payments per person per day) remains constant, this would imply a substitution of 0.2 cash payments per person per day, i.e. a total replacement of 36.5 million payments a year. To assess the social cost implications of this replacement, we use the social cost estimates of cash and debit card payments as reported in Jonker (2013). Moreover, given the relatively limited size of the substitution, we follow Jonker (2013) by leaving the fixed costs unchanged and by only considering changes in the variable social costs. As these variable costs differ by transaction value (see Section 1.2.5), we assume the substituted payments to have the average cash transaction value of EUR 12.19 as reported in Jonker et al. (2012). Based on this, the total realised direct social cost savings would amount to EUR 2.9 million a year (see Table 6.3). Given the total yearly social costs of payments in the Netherlands of around EUR 2.4 billion (Jonker (2013)), this is only a modest efficiency gain. Although this calculation merely serves as an illustration, it makes clear that, at least in the Netherlands, the social benefits would be limited. In particular when taking into consideration that such a campaign would require considerable and long-term investment costs for it to be as successful as hypothesised.

The analyses presented in Chapter 3 focussed on the POS payment

Table 6.3: Illustration of potential yearly social cost savings

	Cash	Debit card
(1) = Social costs of 1 additional payment (EUR)	0.1376	0.16430
(2) = Social costs of EUR 1 in additional sales (EUR)	0.0089	0.00013
(3) = (1)+(2)*EUR 12.19 = Variable social costs of 1 average payment (EUR)	0.25	0.17
(4) = Number of substituted payments a year (million)	-36.5	+36.5
(5) = (3)*(4) = Yearly change in social costs (EUR million)	-9.0	+6.1
(6) = Overall net yearly change in social costs (EUR million)	**-2.9**	

Note: This table presents the results of a stylised analysis illustrating the potential yearly social cost savings to be realised when substituting 36.5 million cash payments by debit card payments in the Netherlands. Calculations are based on the cost estimates reported in Jonker (2013) and on the average cash transaction value of EUR 12.19 reported in Jonker et al. (2012).

choices made by migrants living in the Netherlands. Nevertheless, the conclusions may have wider applicability. First, the conclusion that migrants bring along their home-country POS habits may also apply to their remote payments. For instance, people having a background in countries with low levels of internet use, may be found to be less likely to use internet banking for paying their bills or for transferring money after migration. Hence, again, the answer to the question of whether there is room for a further increase in the use of electronic payments will strongly depend on the size of this particular population group. Second, similar dynamics may be found in countries other than the Netherlands. However, the conclusion that behavioural differences are only present for a limited fraction of the population may not necessarily apply everywhere. In the Netherlands, every person aged 18 years and older having a permanent home address or being registered with a recognised aid or governmental organisation is entitled to open a bank account. Consequently, basically everybody has the opportunity to pay by debit card, including fugitives and migrants. This is not always the case in other countries, where migrants, irrespective of their generation or country of origin, may be less likely to have a bank account (see Section 3.2.2), thereby having no other choice but to rely on cash for their payments. Hence, in these countries, differences in payment behaviour may be found among both the first and the second gen-

eration, as they may not only be caused by home-country habits, but also by general migrant-related barriers faced in the host country. Therefore, in these countries, there may be more room for taking broad-ranging measures and for enticing a substantial shift towards the use of electronic payment instruments.

6.2.3 Role of payments fraud and safety risks

The global trend towards electronic ways of paying has not only created opportunities in terms of social cost savings and improved user satisfaction. It has also introduced new forms of payments fraud and safety risks. Until now, total fraud losses are still small relative to the total size of the electronic payments market. Nevertheless, the overall societal consequences could be more widespread. Due to personal experiences and increasing media attention, consumers may lose their confidence in paying electronically and shift to other ways of paying. As electronic payment instruments are still generally found to be less costly to society than their paper-based counterparts, this could eventually harm the overall cost efficiency of the payment system. Therefore, it is important to have a clear understanding of how consumers' payment choices are affected by payments fraud and safety risks. In this light, this thesis makes a valuable contribution by investigating in Chapter 4 how consumers assess the safety of payment instruments and how this affects their choices between cash and debit cards, and by examining in Chapter 5 whether consumers change their payment behaviour after reading about card fraud in the newspaper. The results provide new insights, which are relevant for central banks, commercial banks, businesses and other participants in the retail payments chain who strive for further stimulating socially cost efficient payment choices. In particular, the results allow for a better understanding of whether safety and fraud currently hinder a further growth in the use of electronic payment instruments or whether they may do so in the near future. In addition, they provide new insights into how to preserve consumers' confidence in

the safety of paying and into how to prevent consumers from reverting to alternative ways of paying that are more costly to society.

First, Chapter 4 demonstrated that consumers' payment choices are significantly influenced by their perceptions of safety. Similar to other research fields, we showed that perceptions of unsafety negatively influence consumers' payment behaviour, i.e. consumers are less likely to use a certain instrument when they perceive it as unsafe. Personal experiences with payments-related safety incidents are shown to play an important role here. People who ever experienced losses or fraud when using or carrying a particular instrument, are shown to be more inclined to view this instrument as unsafe and, hence, to use other ways of paying. Herewith, this thesis demonstrates that fraud and safety incidents do have potential to obstruct a further shift towards electronics, i.e. the more consumers are confronted with incidents with electronic instruments, the more they will switch to other ways of paying. As this may harm the overall social cost efficiency of paying, the results underline the importance of all stakeholders being constantly ready to reduce fraud and safety risks to a minimum.

A second key finding of Chapter 4 is that consumers' views on the safety of POS payment instruments are influenced mainly by their perception of the probability of incidents occurring. As demonstrated in other research fields, consumers do consider the severity of the potential consequences too, though to a much lesser degree. This is an interesting finding and provides a meaningful policy message as to how to further stimulate efficient payment choices. It shows that consumers' feelings of safety could be maintained or even improved in particular by *ex-ante* minimising the probabilities of safety incidents occurring, instead of *ex-post* mitigating the consequences once they have occurred. In this respect, the recent introduction of the EMV technology may be expected to have a positive effect on consumers' feelings of safety, as it aims at preventing card fraud incidents related to the magnetic stripe from occurring. Conversely, measures taken to reduce the ex-post consequences of these incidents, such as compensation schemes,

are likely to be of lesser value in improving consumers' safety perception.

Finally, Chapter 4 suggests that merely taking preventative measures is not enough for preserving consumers' confidence and for further stimulating the use of electronic payment instruments. By showing the importance of consumers' *perceptions* of safety, the findings make clear that it is essential to realise that perceptions may not always reflect reality. Consumers may wrongly perceive certain payment options as unsafe and, therefore, wrongfully avoid them. Similarly, consumers may underestimate the risks of particular incidents and consequently inadequately protect themselves. Therefore, the results suggest an important role for communication to inform the public about the actual safety levels of payment instruments and about the measures taken by the different actors and the steps that consumers can take themselves to minimise payment risks. This communication should not make the public feel insecure. By contrast, if the communication is done in a suitable way, it should improve the perceived level of payments safety, thereby further stimulating consumers to pay in a safe and socially cost efficient way.

The effect of safety incidents on the use of payment instruments is further examined in Chapter 5, where we studied the impact of newspaper publications about debit card skimming fraud on the daily number of debit card payments. Key result is that consumers reduce their card use on days when newspapers report about card fraud. The media effects are, however, relatively small and only last for one day. This corresponds to the conclusions drawn in other research fields and suggests that consumers revert back to their regular payment behaviour almost immediately. Yet, the significance of consumers' reactions and the finding that reactions grow stronger in periods with intensive media attention provide a meaningful policy message. It shows that safety and fraud incidents may not only through personal experiences, but also through the media, pose a barrier to further digitisation. In particular when there is extensive and long-term media coverage. Moreover, it demonstrates again that safety and fraud

incidents may affect the overall social cost efficiency of a payment system when inducing a shift towards means of payment that carry a higher cost to society.

The results of Chapter 5 can be used to get a first impression of the direct social costs of consumers changing their behaviour after reading about payment fraud in the newspaper. The estimation results allow for a calculation of the number of debit card payments that would have been made in the Netherlands over the period 2005 - 2008 in the hypothetical situation that no skimming fraud articles were published. Under this scenario (see Table 6.4, Column 1), the total number of debit card payments would have been 13.1 million higher than the actual number of payments made (see Column 2). This suggests that the fraud publications during this period have triggered a total reduction of 13.1 million card transactions (see Col-

Table 6.4: Estimated social costs of induced change in debit card use

	No. debit card payments			Social costs		
	(1)	(2)	(3)	(4)	(5)	(6)
	Scenario: no pubs. (millions)	Actual (millions)	Induced change (millions)	Variable costs per trx. (EUR)		Costs of induced change (EUR, millions)
				Debit card	Cash	Total
01/05 - 06/07	3,623	3,629	+5.4	0.17	0.54	-1.9
07/07 - 12/07	850	846	-4.8	0.17	0.53	+1.7
01/08 - 06/08	870	868	-2.2	0.17	0.53	+0.7
07/08 - 12/08	911	900	-11.5	0.17	0.52	+4.0
Total	**6,255**	**6,242**	**-13.1**			**+4.5**

Note: Column 2 shows the actual number of debit card payments made in the Netherlands as predicted by the estimates presented in Section 5.4, whereas Column 1 contains predictions based on the same estimates, while assuming no publication of skimming fraud articles. The differences are presented in Column 3. The variable costs of one additional cash and debit card payment are calculated using the figures presented in Row (1) and Row (2) in Table 6.3 and the average debit card transaction values for each period as published by Currence on www.currence.nl. The actual induced change in social costs (Column 6) is calculated by multiplying the difference between Column 4 and Column 5 with Column 3. The sums of the columns may not equal the reported totals due to rounding.

umn 3). The finding that the news effects only lasted for one day not only indicates that consumers almost immediately reverted back to their regular behaviour, but also that they did not delay their debit card payments to a later moment in time. As cash is the only alternative to debit cards in the majority of Dutch shops, this finding suggests that the temporary decline in card use was compensated by a same and immediate increase in cash payments. To assess the social cost implication of this replacement, we again use the social cost estimates and approach of Jonker (2013). Columns 4 and 5 in Table 6.4 show the variable social costs of one additional debit card and cash payment. These estimates are calculated using the figures presented in Row (1) and Row (2) in Table 6.3 and the average debit card transaction values for the concerning periods.[2] After multiplying these social cost estimates with the total number of substituted payments (i.e. -13.1 million debit card and +13.1 million cash payments), the final results suggest that the induced substitution over 2005 - 2008 has led to a total direct social cost increase of around EUR 4.5 million (see Table 6.4, Column 6). To put it differently, the total direct social costs over 2005 - 2008 would have been EUR 4.5 million lower in the fictive scenario of no single fraud publication. The differences between periods are large though. For the second half of 2008, when the papers were full of fraud news, the estimated costs amount to about EUR 4.0 million. This is still a modest sum given the total yearly social costs of cash and debit card payments in the Netherlands of around EUR 2.4 billion (Jonker (2013)). Yet, it shows that the impact of news about safety and fraud incidents on the total social cost efficiency of a payment system is not to be underestimated.[3] This underlines again the importance of effective safety measures, as well as of clear public com-

[2]Average debit card transaction values as reported by Currence on www.currence.nl.

[3]Note that in order to get a full picture of the total welfare effects of media reports, one would also like to consider their potential positive effects. That is, media reports on fraud or safety incidents may raise consumers' awareness and stimulate them to take (more) precautionary measures. Also, extensive media attention may lead to banks and retailers increasing their fraud-reducing efforts, which may eventually result in a total fraud reduction. Hence, in the long run, the overall welfare consequences may not necessarily be negative. Therefore, future research may be valuable here.

munication about actual levels of safety. However, the short-lived effect of newspaper articles suggests that this will require a well-considered and long-term communication plan.

When examining the effect of fraud and safety on consumers' payment choices, the analyses presented in Chapter 4 and Chapter 5 focussed on cash and debit cards only. Nevertheless, the conclusions may have wider applicability, as the various analyses all arrived at the same conclusions. Moreover, the findings correspond very well to the related literature (see Sections 4.2.2 and 5.2.1). Therefore, the conclusions drawn in this thesis concerning the effect of payment incidents on consumers' safety perception and payment choices are likely to also apply to payment instruments other than cash and debit cards. For instance, an increase in internet banking fraud may, either through personal experiences or through the media, be likely to affect consumers' confidence in paying online, and therefore pose a barrier to a further growth in online payments. As discussed above, this emphasises the need for effective safety measures and for clear public communication. These measures and communication should focus on the steps taken by the different actors and on what consumers can do themselves to minimise in particular the ex-ante probability of incidents.

Given the consistency of our findings among the two instruments analysed and the resemblance to the existing literature, the conclusions of this thesis are likely to also apply to other countries. Also there, feelings of unsafety and fraud reports may be found to negatively influence the use of particular instruments. Yet, the degree to which consumers change their behaviour and the extent to which this hinders further digitisation may differ per country, depending on the available payment alternatives. In the Netherlands, the choice at the POS is principally restricted to cash and debit cards. In other countries, however, consumers may have a different range of options, such as credit cards or cheques. Each payment instrument has its own characteristics, for instance in terms of speed or convenience. Also, each country may have different fraud compensation schemes. There-

fore, the final trade-offs and payment choices made in response to changes in perceived safety may vary from one country to another. Moreover, as the social costs of individual payment instruments differ across countries (e.g. Schmiedel et al. (2013)), the social cost implications of fraud and safety incidents may considerably vary across countries as well.

6.3 Room for further digitisation?

Now that we have gained insight into the role of foreign backgrounds and payments safety in consumers' payment choices, in this section we turn to answering the question of whether there is room for further digitisation. Based on the findings as summarised above and taking into account that changing consumers' payment behaviour requires all market participants to make an effort, we take a look forward and discuss whether and how the use of electronic payment instruments may be further increased.

With respect to foreign backgrounds, the findings showed that the potential for a behavioural change is largest among first-generation migrants coming from cash-oriented countries. Given the relatively limited size of this population group, as well as the fact that changing their habits will not be easy, the total room for further digitisation can be concluded to be limited here. Turning to payments safety, the room for further digitisation is relatively small as well. At least, at present. That is, the majority of consumers is currently satisfied with the safety of paying, and the main safety threat over the past years, i.e. the skimming threat, is expected to further decline due to technological improvements. However, the findings clearly show that future safety and fraud incidents with electronic payment instruments do have potential to obstruct a further shift towards electronics, as they will significantly affect consumers' confidence and cause them to revert to other ways of paying.

Regarding the question of how to further stimulate the use of electronic instruments, the results underline the importance of banks and other pay-

ment service providers taking effective safety measures to reduce and to keep fraud and safety risks to a minimum. Similarly, it is important that retailers, businesses and consumers take their responsibility too and protect themselves to the extent possible when making or receiving payments. However, merely taking preventative measures is not enough. As perceptions not always reflect reality, the public needs to be made aware of the actual safety levels of payment instruments, for instance, through publication of safety and fraud statistics. This is where banks and other suppliers, either individually or together, could play an important role. However, given the presence of network externalities in retail payment markets as discussed in Section 1.2.6 and the increasing complexity and scale of fraud incidents, there may be a task for central banks and/or other public authorities too. Due to the interconnectedness of banks and payment systems, fraud and safety incidents may not only affect individual payment instruments or individual banks. Instead, they may affect the entire payment system as a whole. Therefore, it is important that the safety and communication measures taken by the market are well aligned. Coordinating such a joint approach is not easy, in particular in case of a large number of stakeholders. This is where public authorities may step in. They may play an important role by, for example, setting minimum safety requirements, bringing all stakeholders together, and ensuring that roles and responsibilities are well defined. Also, given their independent position, public authorities may play an important role in taking away public uncertainty about the safety of paying and in preserving consumers' confidence through general public communication.

This thesis focussed on the role of foreign backgrounds and payments safety as potential areas for further digitisation. There are, however, also other areas which offer important opportunities for a further shift towards electronics so to reduce the total social costs of a payment system. The results of this thesis make clear that in order to stimulate the use of the most socially cost efficient payment instruments, consumers need to receive the

right incentives. In general, consumers are rarely confronted with transaction fees for the payments they make, as a result of which they are often unaware of the social costs of their behaviour (see also Section 1.2.5). In fact, surcharges used by retailers for card payments (Bolt et al. (2010)) and the large media attention on card fraud may even have lead consumers to wrongly believe that paying electronically is more costly to society than using cash. This unawareness and misperception of the real social costs may, from a social perspective, have resulted in an overuse of cash and other paper-based instruments. Hence, there is considerable room for further digitisation here. In this light, another way to steer consumers towards the most socially cost efficient ways of paying is to increase transparency in the costs of each payment instrument, for example by conducting and publishing social and private cost studies. Here lies an important task for all participants in the payments chain, such as central banks, banks, retailers and businesses. In addition, it is important that the fees paid by consumers reflect the social costs of their choices. This requires a fee structure that takes into account consumers' actual use of payment instruments and where the fees reflect the actual differences in social costs, i.e. where the instrument that is most (least) expensive to society carries the highest (lowest) consumer price. Up till now, banks and businesses in the Netherlands and in many other countries have been reluctant to introduce consumer fees related to the use of cash, such as ATM withdrawal fees or POS cash transaction fees, because of fear of losing clients. Hence, there may be a need for a coordinating and independent body who stimulates a joint move, while also ensuring a proper balance between cooperation on the one hand and competition on the other.

Switching consumers' behaviour towards electronic payment instruments also requires these instruments to bring added value. This may explain the everlasting importance of cash. One of the main characteristics of cash is that it allows for paying anonymously. Moreover, cash is often used for reasons of budget and expense control and for in-person payments between

consumers, such as payments of tips or small donations. Until now, no electronic payment instrument has been able yet to meet these specific demands. Hence, also here, there is still room for further digitisation. A pivotal role may be expected from the smart phone. Due to on-going technological advancements and the increasing demand for real-time services, smart phones have rapidly diffused and offer an immense range of possibilities. During the past decade, various mobile payment solutions have been launched, such as mobile banking applications and SMS-based payment services (CPSS (2012)). However, smart phones may also be used for paying at the POS by swiping the phone in front of a terminal. This potential has not yet been fully realised though. Also, suppliers have not yet been able to launch mobile applications that replicate cash in terms of monitoring expenses and making real-time in-person consumer payments. Explanations may be found in the main economic characteristics of retail payment markets as discussed in Section 1.2.6. Due to the presence of economies of scale and network externalities, there is a strong need for cooperation among suppliers, for example in terms of jointly developing a new system, sharing customer bases to ensure sufficient user demand, or setting common standards to allow for interoperability between individual solutions. Establishing cooperation in the area of mobile payments is not easy, because of the large variety of stakeholders involved, such as banks, mobile network operators, terminal and smart phone manufacturers, as well as retailers. Again, this may require a coordinating body, whose mandate may take on various forms, such as facilitating dialogue among stakeholders or setting common standards. A lack of coordination may delay or even hamper the introduction of mobile payment solutions. In any case, as it generally takes a long time before new payment solutions are widely accepted and used, cash may be expected to remain indispensable in the near-future.

6.4 Directions for future research

6.4.1 Quality of payment diaries

This thesis demonstrates that the number of cash payments made by consumers can be best estimated using a one-day payment diary instead of a retrospective recall survey or a one-week diary. Nevertheless, there are a few issues that may be explored in more detail in order to potentially further improve the quality of payment estimates collected through payment diaries. First, although the cash estimates of the one-day diaries corresponded very well to the retailers' data, all one-day diaries overestimated the real number of debit card payments made. We argued that this may possibly be explained by social desirability, i.e. the desire to somehow report a debit card payment. However, to what extent the card estimates really suffered from social desirability errors remains unanswered. This is an important issue, as similar errors may affect other survey estimates too. Therefore, future empirical work on the degree to which consumers are not honest or change their behaviour when participating in payment surveys because of social desirability could prove fruitful here.

Second, we concluded that one-day diaries are to be preferred over one-week diaries, as the latter may suffer from diary fatigue or diary despair. However, we only examined the effects of one-day and one-week diaries, without considering intermediate alternatives, such as two or three-day diaries. Therefore, it may be worthwhile to further investigate the effects of the length of a payment diary. First, an interesting question is after how many days diary fatigue and diary despair biases come in and how this affects the results over time. Two or three-day diaries, for instance, may well prove to be suitable as well. This may be useful information, as one of the main advantages of multiple-day diaries is that they allow for a collection of a much larger number of observations compared to a one-day diary. A second issue that may be considered when further investigating the effects of diary length is the potential effect of multiple-day diaries on con-

sumers' actual behaviour. A widely acknowledged feature of self-reported diaries is that they may help consumers in obtaining a better insight into their actions. Therefore, they are often used for controlling or changing one's behaviour. Nibud (the Dutch National Institute for Family Finance Information), for example, advices consumers to keep track of their daily expenses using a diary in order to control their spending. Hence, multiple-day payment diaries may have potential to change consumers' behaviour. In view of this, future work assessing the optimal length of payment diaries could be valuable.

Finally, it would be interesting to explore other potential data collection methods than diary surveys or questionnaires. That is, the rapid technological developments have not only lead to new ways of paying, but also to new potential survey tools. For instance, GPS-enabled smart phones may be used to track consumers' actual movements, such as the type of shops visited. Also, smart phones may serve as a valuable substitute for paper-based diaries. For example, special applications could be installed allowing respondents to immediately update their 'mobile' payment diary at the moment a payment is made. This may improve the quality and reliability of the results by reducing potential recall errors.

6.4.2 Role of habits

One issue that remains to be addressed in order to fully understand whether there is room for further digitisation of retail payments is the role of habits. There is still much to learn on how much consumers' payment choices are driven by habits, how these habits are formed, and, more importantly, how they may be changed. The importance of habits in consumers' behaviour is widely acknowledged in other fields of research. It is argued that nearly half of consumers' behaviour consists of habitual behaviour (see Wood and Neal (2009) and references therein). Various studies have also looked at how habits can be changed and at what types of consumers are more open to break their habits (e.g. Verplanken and Wood (2006), Wood (2010)).

For instance, when studying consumers' reactions to innovations, Reinders (2010) shows that forcing consumers to leave their habits and to adopt new behaviours can have adverse consequences.

Nevertheless, research on the role of habits in consumers' payment choices, and into how new payment habits can be adopted is scarce. This thesis does show that habits do play an important role for consumers with a foreign background. It also shows that payment habits are not passed on between generations. This suggests that habits related to payment behaviour are mainly formed there where a person is born and has grown up. This raises some interesting questions. In which stage of life does a person develop its payment habits? What environmental, personal, cultural and other factors play a role here? To what extent are payment habits influenced by shopping habits? How rigid are payment habits and how may they be changed? These are important questions, as they provide a further insight into how to further stimulate the use of electronic payment instruments. Not only among people with a foreign background, but among the entire population. Therefore, future research would be useful.

6.4.3 Safety perception: the interaction between payment instruments

One commonly heard concern related to payment card incidents is that it may lead to consumers moving away from electronic payment instruments in general. This thesis indeed shows that consumers shift away from paying by debit card as soon as they perceive it as unsafe. However, it leaves unanswered to what extent this affects their beliefs about the safety of other ways of paying. For instance, debit card incidents at the POS may harm consumers' confidence in paying by credit card, prepaid card or by online card-based payment solutions as well. The erosion of confidence may even be larger, and also hit other electronic means of payment, such as online credit transfers or mobile payment solutions. Yet, there is little evidence of the presence and nature of these interactions. Future research is therefore

welcomed. The disruptions to the internet banking services in the Netherlands in April 2013 may serve as an interesting case study here. These disruptions were caused by a massive cyberattack, due to which the online banking sites of the main retail banks were intermittently forced offline. As a result, consumers were at various times temporarily unable to access and use their accounts. Although the security of the underlying balances was not breached, it would be interesting to assess how these disruptions have affected consumers' perception and use, not only of internet banking, but also of all other electronic payment instruments. This may help in understanding even better the mechanism between consumers' safety perception and their payment choices, thereby offering a further insight into how to maintain and improve consumers' confidence in paying electronically.

6.4.4 Effects of fraud news

One last area that deserves further exploration is the effect of news about safety concerns. Similar to the results found in other research fields, this thesis demonstrates that news reports do affect consumers' behaviour, but only for a very short time, with consumers reverting back to their regular behaviour almost immediately. Also, it shows that the strength of consumers' reactions weakens after periods of media silence. This suggests that the news effects do not sustain or accumulate in the long run. It is, however, unclear what drives this finding. There are various possible explanations, such as the fact that Dutch banks generally compensate for the damages incurred or the lack of alternative ways of paying other than cash or debit card. Alternatively, it may imply that consumers' confidence is relatively sturdy and not easily affected, or it may simply indicate that consumers have a short memory when it comes to newspaper articles. Therefore, it might be desirable to further explore the reasons behind the short-term effects of fraud news. Future work on this issue may benefit from combining actual aggregated transaction records with self-reported survey data. The advantage of actual aggregated transaction data, such as used in Chapter 5,

is that they provide a good basis for examining *actual* payment behaviour and for studying macro changes over time. By contrast, self-reported survey data, such as the data employed in Chapter 4, allow for an indepth analysis of individual preferences and of the underlying motivations. Therefore, when exploiting both actual and self-reported payments data, one may be better equipped to gain deeper understanding of consumers' reactions to fraud publications. In doing so, the analyses would benefit from also using actual fraud data. This allows for assessing whether consumers' reactions are driven purely by the newspaper publications or (also) by the size and scale of the underlying fraud incidents. In addition, it might be valuable to further explore whether and how consumers' reactions change and accumulate over time, for instance by using a longer time-series or other research methods, such as event studies.

Finally, a relevant question that remains unanswered is whether consumers' reactions to fraud news vary with the type of media source. The latest developments in the information and communication technology have not only changed the way consumers pay, but also the way they receive and exchange information. Consumers rely less and less on the traditional media, such as newspapers and the television, and increasingly use online media sources. Moreover, news and information is increasingly shared in online social forums, such as Facebook and Twitter. An important feature of these social media is that it allows for an immediate and continuous exchange of information. Hence, disruptions and incidents in payments may immediately be picked up and spread, thereby having the potential to affect the general public's behaviour long before the newspapers are even published. At the same time, given the actuality and continuity of the information flows in social media, news about payment incidents may also be argued to quickly lose its newsworthiness, due to which its impact may be limited. In sum, how consumers react to safety incidents reported via social media is still unclear and invites more research.

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Nederlandse Samenvatting (Summary in Dutch)

Dit proefschrift bestudeert het gebruik van betaalmiddelen door consumenten. De laatste jaren betalen zij steeds vaker elektronisch. Zo is betalen met een pinpas of via internet voor velen niet meer weg te denken. Elektronisch betalen brengt over het algemeen lagere maatschappelijke kosten met zich mee dan betalen met contant geld of andere papieren betaalvormen. Dit betekent dat een verdere verschuiving naar elektronisch betalen kan leiden tot besparingen voor de maatschappij. Toch is contant geld nog altijd het meest gebruikte betaalmiddel en wordt nog vaak met papieren overschrijvingen betaald. Blijkbaar zijn er nog voldoende redenen voor de consument om te kiezen voor de traditionele methodes. Het voornaamste doel van dit proefschrift is te onderzoeken wat de onderliggende factoren zijn voor de betaalkeuze van consumenten. We kijken in het bijzonder naar de keuze tussen contant geld en de pinpas. Door te onderzoeken welke factoren hierbij een rol spelen, geeft dit proefschrift inzicht in of en hoe elektronisch betalen verder gestimuleerd kan worden. Hoewel het betaalgedrag van consumenten vaker is bestudeerd, is er nog weinig onderzoek gedaan naar de rol van afkomst en etniciteit en naar het effect van veiligheid en fraude. Daarom richt dit proefschrift zich op deze twee onderwerpen.

Het onderzoek is gebaseerd op diverse datasets. Belangrijk is dat de data een correcte weergave is van de daadwerkelijke betaalkeuzes van de consument. Daarom doen we in dit proefschrift eerst een stapje terug.

We beginnen met een uitgebreid onderzoek naar welke methode het meest geschikt is om alle consumentenbetalingen, en met name de contante betalingen, in kaart te brengen. Hieruit blijkt dat het gebruik van contant geld het best gemeten kan worden door consumenten te vragen al hun betalingen te registreren in een dagboekje. Zonder deze geheugensteun blijken zij namelijk veel betalingen te vergeten. Vooral de kleine betalingen. De periode dat het dagboekje bijgehouden moet worden mag echter niet te lang zijn, want ook dan is er sprake van een vergeeteffect. Waarschijnlijk doordat na verloop van tijd de motivatie en nauwkeurigheid afneemt. Daarom is voor de studie naar de rol van afkomst en etniciteit gebruik gemaakt van een 1-daags dagboekje. Het onderzoek naar de impact van veiligheid en fraude is gebaseerd op een apart consumentenonderzoek. Ook is gebruik gemaakt van betaalgegevens van Equens en van het krantenarchief van LexisNexis.

Aangaande het effect van etniciteit blijkt dat de betaalkeuze van consumenten afhangt van waar men vandaan komt. Zo blijkt dat consumenten die afkomstig zijn uit landen waar veel contant wordt betaald ook na hun migratie relatief vaak contant betalen. Dit laat zien dat consumenten hun betaalgewoontes meenemen wanneer zij migreren. Dit zogenoemde thuisland-effect beïnvloedt echter alleen het gedrag van hen die daadwerkelijk in het buitenland is geboren. Bij de tweede generatie speelt het geen rol meer. Of hier nog ruimte is voor een grootschalige verschuiving naar elektronisch betalen is dan ook de vraag. Dit hangt sterk af van de omvang van de specifieke groep consumenten die geboren is in cash-georiënteerde landen. In Nederland is dit een beperkte groep. Bovendien zijn gewoontes over het algemeen moeilijk te veranderen. Daarom is het de vraag of de kosten van eventuele doelgerichte publiekscampagnes zullen opwegen tegen de mogelijk te behalen maatschappelijke kostenvoordelen.

Ondanks de voordelen van elektronisch betalen heeft het de laatste jaren ook geleid tot nieuwe veiligheidsrisico's. De resultaten laten zien dat veiligheidsincidenten in het betalingsverkeer een verdere verschuiving

naar elektronisch betalen kunnen belemmeren. Wanneer consumenten een incident hebben meegemaakt met een betaalmiddel, dan vinden ze dit betaalmiddel over het algemeen minder veilig. Ook blijkt dat ze in reactie hierop geneigd zijn om op een andere manier te betalen. Naast persoonlijke ervaringen speelt ook de media een belangrijke rol. Zo blijkt dat consumenten de afgelopen jaren minder vaak pinden op de dagen dat er iets in de krant stond over pinpasfraude. Het effect van de berichtgeving was echter wel van korte duur. Alleen op de publicatiedag zelf nam het aantal pinbetalingen af. De dag erna verviel men weer in de oude gewoonte. Toch laten de resultaten zien dat veiligheidsincidenten aanzienlijke gevolgen kunnen hebben voor het betaalgedrag van consumenten en dus uiteindelijk ook voor de totale maatschappelijke kosten van het betalingsverkeer. Dit onderstreept het belang van effectieve maatregelen om fraude en veiligheidsrisico's te beperken. Bovendien laat het zien hoe belangrijk het is dat consumenten worden gewezen op de werkelijke risico's van betaalmiddelen. Het treffen van maatregelen om de schade van incidenten te verzachten zal het betaalgedrag echter minder sterk beïvloeden. Uit het onderzoek blijkt namelijk dat consumenten bij hun betaalkeuze vooral kijken naar de kans op incidenten en niet zo zeer naar de omvang van de mogelijke gevolgen ervan.

Résumé Français (Summary in French)

Cette thèse est consacrée à l'étude de l'utilisation des moyens de paiement par les consommateurs. Ces dernières années le recours aux instruments de paiement électroniques est devenu de plus en plus fréquent. Pour la plupart des consommateurs, payer à l'aide d'une carte bancaire ou par Internet n'est plus du tout exclu. Les coûts sociaux associés aux paiements électroniques sont, de manière générale, inférieurs à ceux qu'engendrent les paiements en espèces et les autres instruments sous forme papier. Cela signifie qu'une utilisation accrue des paiements électroniques pourrait conduire la société à réaliser des économies. Cependant, les espèces demeurent l'instrument de paiement le plus utilisé et il est encore souvent fait usage du virement papier. Vraisemblablement, il subsiste des raisons qui conduisent le consommateur à privilégier des modes de paiement traditionnels. L'objectif principal de cette thèse est d'examiner quels sont les facteurs sous-jacents qui orientent les préférences des consommateurs en matière de paiement. Une attention plus particulière est apportée au choix entre espèces et cartes bancaires. En étudiant les facteurs qui interviennent pour faire ce choix, cette thèse donne une idée de la manière dont l'usage des paiements électroniques peut être stimulé. Bien que le comportement des consommateurs en matière de paiement ait été souvent étudié, il existe peu d'études consacrées à l'influence de l'origine et de l'ethnicité d'une part et à l'effet de la sécurité et des fraudes d'autre part. C'est pourquoi cette

thèse se concentre sur ces deux thèmes.

La recherche est basée sur divers ensembles de données. L'important étant que ces données reflètent de manière exacte le choix des consommateurs en matière de paiement. Pour cette raison, cette thèse prend d'abord un peu de recul. Nous commençons avec une recherche approfondie dont l'objectif est de déterminer quelle méthode est la plus appropriée pour cartographier tous les paiements des consommateurs, et en particulier les paiements en espèces. Il en ressort que la meilleure manière de mesurer l'utilisation des espèces est de demander aux consommateurs de consigner tous leur paiements dans un journal. Sans un tel aide-mémoire, ils semblent en fait oublier de nombreux paiements, surtout s'il s'agit de petits montants. La période couverte par le journal ne doit être trop longue sinon, là aussi, on observe des oublis. Vraisemblablement, avec le temps, la motivation et la rigueur diminuent. Pour cette raison, dans le cadre de l'étude du rôle de l'origine et de l'ethnicité, un journal couvrant une seule journée a été utilisé. La recherche consacrée à l'impact de la sécurité et de la fraude est basée sur une enquête de consommation distincte. Pour celle-ci, des données concernant les paiements provenant d'Equens et des archives de LexisNexis ont également été utilisées.

Pour ce qui concerne l'effet de l'ethnicité, il semble que les choix des consommateurs en matière de paiements dépendent de leurs origines. Les consommateurs originaires de pays où les paiements en espèces sont fréquents continuent à payer relativement souvent en espèces après avoir émigré. Il apparaît donc que, lorsqu'ils migrent, les consommateurs emmènent avec eux leurs habitudes de paiement. Cet effet lié à la patrie d'origine n'influence toutefois que les migrants nés à l'étranger. Dès la deuxième génération, il ne joue plus aucun rôle. La question est également de savoir s'il reste de la marge pour un basculement à grande échelle vers les paiements électroniques. La réponse dépend dans une large mesure de l'importance du groupe des consommateurs nés dans les pays où les espèces sont beaucoup utilisées. Aux Pays-Bas, il s'agit d'un groupe restreint. De plus, les habitudes sont

en général difficiles à modifier. Dès lors, la question se pose de savoir si les coûts d'éventuelles campagnes publiques visant à promouvoir le basculement seront contrebalancés par les gains attendus.

Malgré les avantages du paiement électronique, il a également engendré ces dernières années de nouveaux risques en matière de sécurité. Les résultats de cette étude permettent de constater que les incidents relatifs à la sécurité des paiements électroniques peuvent constituer un obstacle à une plus large utilisation de ces instruments. Lorsque les consommateurs font l'expérience d'un incident avec un instrument de paiement, ils considèrent en général que ce dernier est moins sûr. Il semble également qu'en réaction, ils ont tendance à payer d'une autre manière. Outre l'expérience personnelle, les média semblent également jouer un rôle important. Il apparaît en effet ces dernières années que les consommateurs utilisent moins souvent leurs cartes bancaires les jours où la presse relate une fraude. L'effet de l'information est cependant de courte durée. Le nombre de paiements par carte diminue uniquement le jour de la publication. Le lendemain, les habitudes sont reprises. Les résultats révèlent donc que les incidents peuvent avoir des conséquences considérables sur les comportements des consommateurs pour ce qui concerne les paiements et par conséquent aussi sur l'ensemble des coûts sociaux liés aux paiements. Cela met en évidence l'importance des mesures destinées à limiter la fraude et les risques. Ils montrent également à quel point il est important d'informer les consommateurs sur les risques réels liés aux moyens de paiement. Prendre des mesures pour atténuer les dommages des incidents, aura une plus faible influence sur les comportements. L'étude montre qu'en fait, lorsqu'ils choisissent un mode de paiement, les consommateurs regardent surtout le risque d'incident et pas tellement l'ampleur des conséquences qu'il pourrait avoir.

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There is a large variety of instruments that consumers can use for making payments. The use of electronic payment instruments, such as payment cards and online transfers, has considerably increased over the past decades. Yet, consumers still heavily rely on cash and other paper-based means of payment. The objective of this thesis is to examine the drivers underlying consumers' choice of which payment instruments to use for their transactions. More specifically, in three empirical studies, this thesis examines how consumers' payment choices are influenced by foreign backgrounds and by payments safety. However, as having accurate data on the use of payment instruments is key to assessing the drivers underneath, this thesis first takes one step back and provides a profound analysis of how to best measure consumers' payment behaviour, and in particular their use of cash.

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